

ASTRONOMICAL PHENOMENA

FOR THE YEAR

2016

Prepared Jointly by
The Nautical Almanac Office
United States Naval Observatory
and

Her Majesty's Nautical Almanac Office
United Kingdom Hydrographic Office

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ASTRONOMICAL PHENOMENA

FOR THE YEAR 2016

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The astronomical data in this booklet are expressed in the scale of universal time (UT); this is also known as Greenwich mean time (GMT) and is the standard time of the Greenwich meridian (0° of longitude). A time in UT may be converted to local mean time by the addition of east longitude (or subtraction of west longitude), where the longitude of the place is expressed in time-measure at the rate of 1 hour for every 15°. The differences between standard times and UT are indicated in the chart on page 22; local clock times may, however, differ from these standard times, especially in summer when clocks are often advanced by 1 hour.

PRINCIPAL PHENOMENA OF SUN AND MOON, 2016

THE SUN

			^d	^h				^d	^h	^m				^d	^h	^m
Perigee	...	Jan.	2	23	Equinoxes	...	Mar.	20	04	30	...	...	Sept.	22	14	21
Apogee	...	July	4	16	Solstices	...	June	20	22	34	...	...	Dec.	21	10	44

PHASES OF THE MOON

Lunation	New Moon				First Quarter				Full Moon				Last Quarter			
		d	h	m		d	h	m		d	h	m		d	h	m
1150													Jan.	2	05	30
1151	Jan.	10	01	31	Jan.	16	23	26	Jan.	24	01	46	Feb.	1	03	28
1152	Feb.	8	14	39	Feb.	15	07	46	Feb.	22	18	20	Mar.	1	23	11
1153	Mar.	9	01	54	Mar.	15	17	03	Mar.	23	12	01	Mar.	31	15	17
1154	Apr.	7	11	24	Apr.	14	03	59	Apr.	22	05	24	Apr.	30	03	29
1155	May	6	19	30	May	13	17	02	May	21	21	14	May	29	12	12
1156	June	5	03	00	June	12	08	10	June	20	11	02	June	27	18	19
1157	July	4	11	01	July	12	00	52	July	19	22	57	July	26	23	00
1158	Aug.	2	20	45	Aug.	10	18	21	Aug.	18	09	27	Aug.	25	03	41
1159	Sept.	1	09	03	Sept.	9	11	49	Sept.	16	19	05	Sept.	23	09	56
1160	Oct.	1	00	11	Oct.	9	04	33	Oct.	16	04	23	Oct.	22	19	14
1161	Oct.	30	17	38	Nov.	7	19	51	Nov.	14	13	52	Nov.	21	08	33
1162	Nov.	29	12	18	Dec.	7	09	03	Dec.	14	00	06	Dec.	21	01	56
1163	Dec.	29	06	53												

ECLIPSES AND TRANSIT OF MERCURY

A total eclipse of the Sun	Mar. 8-9	Eastern Asia, northern and western Australasia and northern Oceania.
A penumbral eclipse of the Moon	Mar. 23	Western parts of South America, North America, Oceania, Australasia and Asia.
A transit of Mercury	May 9	Most of Asia (except S.E. and Japan), Europe, Africa, Greenland, S. America, N. America and most of the Pacific Ocean.
A penumbral eclipse of the Moon	Aug. 18	South America except easternmost part, North America, Oceania, Australasia and easternmost Asia.
An annular eclipse of the Sun	Sept. 1	Africa (except northernmost parts), Madagascar and parts of Antarctica.
A penumbral eclipse of the Moon	Sept. 16	Australasia, Asia, Africa, Europe and easternmost South America.

MOON AT PERIGEE

	d	h		d	h		d	h
Jan.	15	02	June	3	11	Oct.	17	00
Feb.	11	03	July	1	07	Nov.	14	11
Mar.	10	07	July	27	12	Dec.	12	23
Apr.	7	18	Aug.	22	01			
May	6	04	Sept.	18	17			

MOON AT APOGEE

	d	h		d	h		d	h
Jan.	2	12	May	18	22	Oct.	4	11
Jan.	30	09	June	15	12	Oct.	31	19
Feb.	27	03	July	13	05	Nov.	27	20
Mar.	25	14	Aug.	10	00	Dec.	25	06
Apr.	21	16	Sept.	6	19			

OCCULTATIONS OF PLANETS AND BRIGHT STARS BY THE MOON

Date		Body	Areas of Visibility
d	h		
Jan.	20 03	<i>Aldebaran</i>	Hawaii, N. Mexico, USA, Canada, S. Greenland, W. Europe
Feb.	16 08	<i>Aldebaran</i>	Most of S.E. Asia, S. China, Japan, Hawaii, westernmost USA
Mar.	14 14	<i>Aldebaran</i>	N. Africa, S.E. Europe, Middle East, India, China, most of S.E. Asia
Apr.	6 08	Venus	N. Africa, Europe, N. Middle East, N.W. Asia
Apr.	9 04	Vesta	Indonesia, Malaysia, extreme northwestern Australia, most of the Philippines, Micronesia, Hawaii
Apr.	10 22	<i>Aldebaran</i>	Hawaii, N. Mexico, USA, S. Canada, N. Caribbean, the Azores
May	8 09	<i>Aldebaran</i>	N. and N.E. Africa, S. Europe, Middle East, Russia, China, Japan
June	3 10	Mercury	Parts of Antarctica, southern Africa, Madagascar
June	26 01	Neptune	Central and northern Europe, westernmost Russia
July	2 04	<i>Aldebaran</i>	N.E. Africa, southeasternmost Europe, Middle East, southern Russia, China, Japan
July	9 10	Jupiter	S. Madagascar, southern tip of Africa, East Antarctica
July	23 06	Neptune	Central and eastern North America, Greenland, Iceland, northern Scandinavia
July	29 11	<i>Aldebaran</i>	Central America, Caribbean, eastern USA, S. Europe, N. Africa
Aug.	4 22	Mercury	N. New Zealand, Pacific islands, S. tip of South America
Aug.	6 04	Jupiter	Eastern S.E. Asia, Papua New Guinea, northernmost Australia, Pacific islands
Aug.	19 12	Neptune	Eastern Asia, Alaska, N.W. Canada
Aug.	25 17	<i>Aldebaran</i>	Papua New Guinea, Hawaii, southern USA, Mexico, northern Central America
Sep.	2 22	Jupiter	Easternmost part of Russia, southwestern USA, Central America, N. South America, Caribbean
Sep.	3 11	Venus	Central Russia, northern Mongolia
Sep.	15 20	Neptune	Europe, western Russia
Sep.	21 23	<i>Aldebaran</i>	Eastern Africa, Middle East, central and parts of South Asia
Sep.	29 11	Mercury	E. South America, S. tip of South Africa, parts of Antarctica
Oct.	13 06	Neptune	Easternmost part of Russia, Alaska, N.W. Canada
Oct.	19 07	<i>Aldebaran</i>	Mexico, Central America, S.E. Canada, eastern USA, southern Europe, N.W. Africa
Nov.	9 15	Neptune	Northernmost Africa, E. Europe, western Asia
Nov.	15 17	<i>Aldebaran</i>	Middle East, central Asia, Japan
Dec.	6 22	Neptune	Central America, USA, S. and E. Canada, Greenland, Iceland, westernmost Europe
Dec.	13 05	<i>Aldebaran</i>	N. Mexico, USA, S. and E. Canada, southern tip of Greenland, westernmost Europe, northwestern Africa
Dec.	18 19	<i>Regulus</i>	Parts of Antarctica, southernmost Australia

Maps showing the areas of visibility may be found on AsA-Online.

GEOCENTRIC PHENOMENA

MERCURY

		d	h		d	h		d	h		d	h	
Stationary	...	Jan.	5	05	Apr.	29	04	Aug.	30	01	Dec.	19	07
Inferior conjunction	...	Jan.	14	14	May	9	15	Sept.	13	00	Dec.	28	19
Stationary	...	Jan.	25	19	May	21	22	Sept.	21	10			—
Greatest elongation West		Feb.	7	01 (26°)	June	5	09 (24°)	Sept.	28	20 (18°)			—
Superior conjunction	...	Mar.	23	20	July	7	03	Oct.	27	16			—
Greatest elongation East		Apr.	18	14 (20°)	Aug.	16	21 (27°)	Dec.	11	05 (21°)			—

VENUS

	d	h
Superior conjunction	June	6 22

EARTH

		d	h			d	h	m			d	h	m		
Perihelion	...	Jan.	2	23	Equinoxes	...	Mar.	20	04	30	...	Sept.	22	14	21
Aphelion	...	July	4	16	Solstices	...	June	20	22	34	...	Dec.	21	10	44

SUPERIOR PLANETS

		Stationary		Opposition		Stationary		Conjunction	
		d	h	d	h	d	h	d	h
Mars	...	Apr.	17 02	May	22 11	June	30 08	—	
Jupiter	...	Jan.	8 20	Mar.	8 11	May	9 23	Sept.	26 07
Saturn	...	Mar.	25 13	June	3 07	Aug.	13 18	Dec.	10 12
Uranus	...	July	30 02	Oct.	15 11	Dec.	29 16	Apr.	9 21
Neptune	...	June	14 08	Sept.	2 17	Nov.	20 10	Feb.	28 16

The vertical bars indicate where the dates for the planet are not in chronological order.

HELIOCENTRIC PHENOMENA

	Perihelion		Aphelion		Ascending Node		Greatest Lat. North		Descending Node		Greatest Lat. South	
Mercury	Jan.	8	Feb.	21	Jan.	4	Jan.	18	Feb.	11	Mar.	12
	Apr.	5	May	19	Apr.	1	Apr.	15	May	9	June	8
	July	2	Aug.	15	June	28	July	12	Aug.	5	Sept.	4
	Sept.	28	Nov.	11	Sept.	23	Oct.	8	Nov.	1	Dec.	1
	Dec.	25	—		Dec.	20	—		—		—	
Venus	—		Mar.	20	—		Aug.	1	Feb.	14	Apr.	11
	July	11	Oct.	31	June	7	—		Sept.	26	Nov.	22
Mars	Oct.	29	—		—		—		Apr.	28	Oct.	3

Jupiter: Greatest Lat. North, Dec. 28
Saturn, Uranus, Neptune: None in 2016

VISIBILITY OF PLANETS

MERCURY can only be seen low in the east before sunrise, or low in the west after sunset (about the time of beginning or end of civil twilight). It is visible in the mornings between the following approximate dates: January 20 to March 14, May 19 to June 30 and September 20 to October 15. The planet is brighter at the end of each period, (the best conditions in northern latitudes occur from late September to early October and in southern latitudes in mid-February and late May until mid-June). It is visible in the evenings between the following approximate dates: January 1 to January 9, April 1 to April 30, July 15 to September 6 and November 13 to December 23. The planet is brighter at the beginning of each period, (the best conditions in northern latitudes occur in mid-April and in southern latitudes in mid-August). Mercury transits the Sun's disk on May 9 at 11^h 12^m to 18^h 42^m. The event is visible from most of Asia (except S.E. and Japan), Europe, Africa, Greenland, South America, North America and most of the Pacific Ocean.

VENUS is a brilliant object in the morning sky from the beginning of the year until the end of April after which it becomes too close to the Sun for observation. From mid-July it reappears in the evening sky where it stays until the end of the year. Venus is in conjunction with Mercury on July 16 and August 27, with Jupiter on August 27 and with Saturn on January 9 and October 30.

MARS rises shortly after midnight at the beginning of the year in Virgo. It moves into Libra in mid-January, Scorpius from mid-March and into Ophiuchus from early April returning to Scorpius at the beginning of May. The westward elongation gradually increases until opposition on May 22, when it can be seen throughout the night. The planet enters Libra in late May, Scorpius in early August, Ophiuchus in the second half of August (passing 1°8'N of *Antares* on August 24), back into Scorpius in late August and once again into Ophiuchus in early Sept. From early Sept. until the end of the year it can only be seen in the evening sky, moving into Sagittarius in the second half of Sept., Capricornus in early November and into Aquarius from mid-December. Mars is in conjunction with Saturn on August 25.

JUPITER can be seen from the beginning of the year until early March for more than half the night in Leo. It is at opposition on March 8 when it can be seen throughout the night. By early June it can be seen only in the evening sky, passing into Virgo in early August. From mid-September it becomes too close to the Sun for observation until in the second week of October when it reappears in the morning sky. Jupiter is in conjunction with Venus on August 27 and with Mercury on October 11.

SATURN rises before sunrise at the beginning of the year in Ophiuchus, in which constellation it remains throughout the year, and can only be seen in the morning sky until early March. Its westward elongation gradually increases until it is at opposition on June 3, when it can be seen throughout the night. From late August until late November it can only be seen in the evening sky and then becomes too close to the Sun for observation until late December, when it reappears in the morning sky. Saturn is in conjunction with Venus on January 9 and October 30 and with Mars on August 25.

URANUS is visible at the beginning of the year in Pisces and remains in this constellation throughout the year. From early January it can only be seen in the evening sky until shortly after mid-March when it becomes too close to the Sun for observation. It reappears in early May in the morning sky and is at opposition on October 15. Its eastward elongation gradually decreases and Uranus can be seen for more than half the night.

NEPTUNE is visible at the beginning of the year in the evening sky in Aquarius and remains in this constellation throughout the year. In early February it becomes too close to the Sun for observation and reappears a few days after mid-March in the morning sky. Neptune is at opposition on September 2 and from early December can only be seen in the evening sky.

DO NOT CONFUSE (1) Venus with Saturn in the first half of January and again in late October to early November, with Mercury in mid-February and again in mid-July and with Jupiter in late August to the start of September; on all occasions Venus is the brighter object. (2) Jupiter with Mercury in the second half of August and again in mid-October; on both occasions Jupiter is the brighter object. (3) Saturn with Mars in late August when Mars is the brighter object, and with Mercury in mid-November when Mercury is the brighter object.

VISIBILITY OF PLANETS IN MORNING AND EVENING TWILIGHT

	Morning	Evening
Venus	January 1 – April 30	July 14 – December 31
Mars	January 1 – May 22	May 22 – December 31
Jupiter	January 1 – March 8 October 10 – December 31	March 8 – September 13
Saturn	January 1 – June 3 December 28 – December 31	June 3 – November 23

VISIBILITY OF PLANETS

The planet diagram on page 9 shows, in graphical form for any date during the year, the local mean times of meridian passage of the Sun, of the five planets, Mercury, Venus, Mars, Jupiter and Saturn, and of every 2^h of right ascension. Intermediate lines, corresponding to particular stars, may be drawn in by the user if desired. The diagram is intended to provide a general picture of the availability of planets and stars for observation during the year.

On each side of the line marking the time of meridian passage of the Sun, a band 45^m wide is shaded to indicate that planets and most stars crossing the meridian within 45^m of the Sun are generally too close to the Sun for observation.

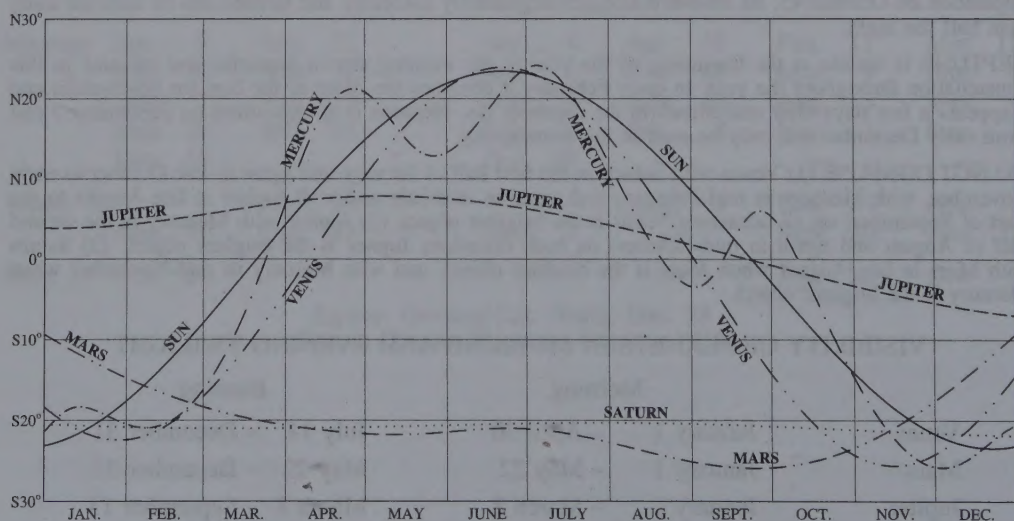
For any date the diagram provides immediately the local mean time of meridian passage of the Sun, planets and stars, and thus the following information:

- whether a planet or star is too close to the Sun for observation;
- visibility of a planet or star in the morning or evening;
- location of a planet or star during twilight;
- proximity of planets to stars or other planets.

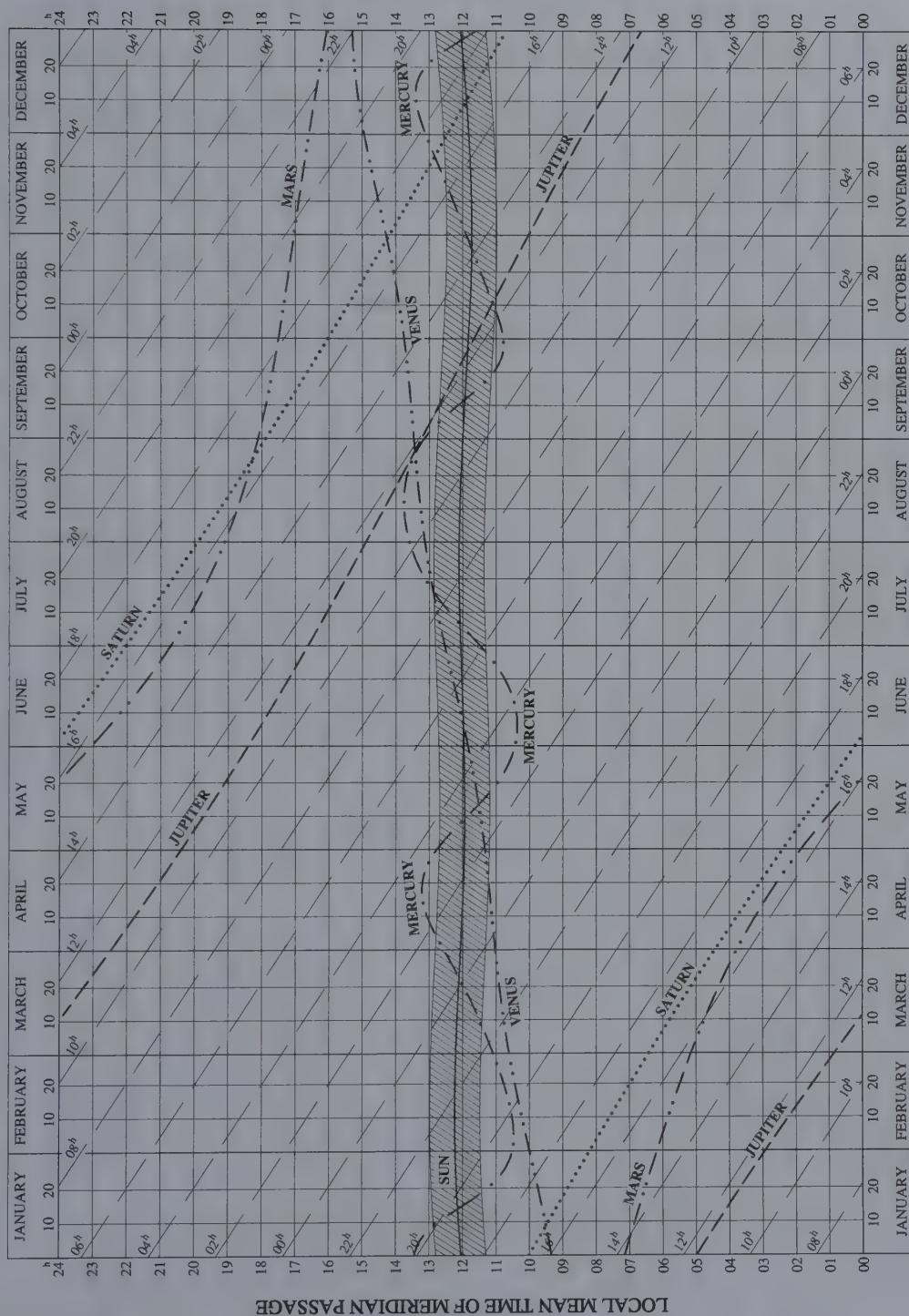
When the meridian passage of a body occurs at midnight, it is close to opposition to the Sun and is visible all night, and may be observed in both morning and evening twilights. As the time of meridian passage decreases, the body ceases to be observable in the morning, but its altitude above the eastern horizon during evening twilight gradually increases until it is on the meridian at evening twilight. From then onwards the body is observable above the western horizon, its altitude at evening twilight gradually decreasing, until it becomes too close to the Sun for observation. When it again becomes visible, it is seen in the morning twilight, low in the east. Its altitude at morning twilight gradually increases until meridian passage occurs at the time of morning twilight, then as the time of meridian passage decreases to 0^h , the body is observable in the west in the morning twilight with a gradually decreasing altitude, until it once again reaches opposition.

Notes on the visibility of the planets are given on page 7. Further information on the visibility of planets may be obtained from the diagram below which shows, in graphical form for any date during the year, the declinations of the bodies plotted on the planet diagram on page 9.

DECLINATION OF SUN AND PLANETS, 2016



LOCAL MEAN TIME OF MERIDIAN PASSAGE



ELONGATIONS AND MAGNITUDES OF PLANETS AT 0^h UT

Mercury					Venus										
Date		Elong. Mag.			Date		Elong. Mag.								
		°					°								
Jan.	-2	E.	20	-0.6	W.	39	-4.1	July	1	W.	7	-1.6	E.	7	-3.9
	3	E.	18	-0.2	W.	38	-4.0		6	W.	2	-2.2	E.	8	-3.9
	8	E.	13	+1.3	W.	37	-4.0		11	E.	5	-1.7	E.	9	-3.9
	13	E.	5	+4.6	W.	36	-4.0		16	E.	10	-1.1	E.	11	-3.9
	18	W.	9	+3.3	W.	35	-4.0		21	E.	15	-0.7	E.	12	-3.9
Feb.	23	W.	17	+1.1	W.	33	-4.0	Aug.	26	E.	19	-0.4	E.	14	-3.9
	28	W.	22	+0.2	W.	32	-3.9		31	E.	22	-0.2	E.	15	-3.9
	2	W.	25	0.0	W.	31	-3.9		5	E.	25	0.0	E.	16	-3.8
	7	W.	26	-0.1	W.	30	-3.9		10	E.	26	+0.1	E.	18	-3.8
	12	W.	25	-0.1	W.	29	-3.9		15	E.	27	+0.2	E.	19	-3.8
Mar.	17	W.	24	-0.1	W.	28	-3.9	Sept.	20	E.	27	+0.3	E.	20	-3.8
	22	W.	22	-0.1	W.	27	-3.9		25	E.	26	+0.5	E.	22	-3.8
	27	W.	20	-0.2	W.	26	-3.9		30	E.	22	+1.0	E.	23	-3.8
	3	W.	17	-0.4	W.	25	-3.8		4	E.	17	+1.9	E.	24	-3.8
	8	W.	14	-0.6	W.	23	-3.8		9	E.	9	+3.8	E.	25	-3.8
Apr.	13	W.	10	-0.9	W.	22	-3.8	Oct.	14	W.	4	.	E.	27	-3.9
	18	W.	6	-1.3	W.	21	-3.8		19	W.	11	+2.5	E.	28	-3.9
	23	W.	2	-2.0	W.	20	-3.8		24	W.	16	+0.4	E.	29	-3.9
	28	E.	4	-1.8	W.	19	-3.8		29	W.	18	-0.6	E.	30	-3.9
	2	E.	10	-1.5	W.	17	-3.8		4	W.	16	-0.9	E.	31	-3.9
May	7	E.	14	-1.1	W.	16	-3.8	Nov.	9	W.	13	-1.0	E.	33	-3.9
	12	E.	18	-0.7	W.	15	-3.8		14	W.	10	-1.1	E.	34	-3.9
	17	E.	20	-0.2	W.	14	-3.8		19	W.	6	-1.3	E.	35	-3.9
	22	E.	19	+0.6	W.	12	-3.8		24	W.	3	-1.4	E.	36	-4.0
	27	E.	17	+1.8	W.	11	-3.9		29	E.	1	.	E.	37	-4.0
June	2	E.	11	+3.4	W.	10	-3.9	Dec.	3	E.	4	-1.1	E.	38	-4.0
	7	E.	4	.	W.	8	-3.9		8	E.	7	-0.8	E.	39	-4.0
	12	W.	4	.	W.	7	-3.9		13	E.	10	-0.7	E.	40	-4.1
	17	W.	11	+3.7	W.	6	-3.9		18	E.	12	-0.5	E.	41	-4.1
	22	W.	17	+2.4	W.	4	-3.9		23	E.	15	-0.5	E.	42	-4.1
July	27	W.	21	+1.4	W.	3	-3.9	Dec.	28	E.	17	-0.5	E.	43	-4.2
	1	W.	24	+0.8	W.	2	-4.0		3	E.	19	-0.5	E.	43	-4.2
	6	W.	24	+0.4	0	.	8		E.	20	-0.5	E.	44	-4.2	
	11	W.	23	0.0	E.	1	.		13	E.	21	-0.5	E.	45	-4.3
	16	W.	21	-0.3	E.	3	-4.0		18	E.	18	0.0	E.	45	-4.3
July	21	W.	18	-0.7	E.	4	-3.9	Dec.	23	E.	12	+1.6	E.	46	-4.4
	26	W.	13	-1.1	E.	5	-3.9		28	E.	3	.	E.	46	-4.4
	1	W.	7	-1.6	E.	7	-3.9		33	W.	10	+2.6	E.	47	-4.4

ELONGATIONS AND MAGNITUDES OF PLANETS AT 0^h UT

Date		Mars		Jupiter		Saturn		Uranus		Neptune	
		Elong.	Mag.	Elong.	Mag.	Elong.	Mag.	Elong.	Mag.	Elong.	Mag.
Jan.	-7	W. 68	+1.3	W. 99	-2.1	W. 22	+0.5	E. 105	+5.8	E. 66	+7.9
	3	W. 72	+1.2	W. 109	-2.2	W. 31	+0.5	E. 95	+5.8	E. 56	+7.9
	13	W. 77	+1.1	W. 119	-2.2	W. 40	+0.5	E. 84	+5.8	E. 46	+7.9
	23	W. 82	+1.0	W. 129	-2.3	W. 49	+0.5	E. 74	+5.8	E. 36	+8.0
Feb.	2	W. 87	+0.8	W. 140	-2.4	W. 58	+0.5	E. 65	+5.9	E. 26	+8.0
Mar.	12	W. 92	+0.6	W. 151	-2.4	W. 68	+0.5	E. 55	+5.9	E. 16	+8.0
	22	W. 98	+0.4	W. 162	-2.5	W. 77	+0.5	E. 45	+5.9	E. 6	+8.0
	3	W. 104	+0.2	W. 174	-2.5	W. 87	+0.5	E. 36	+5.9	W. 3	+8.0
	13	W. 110	0.0	E. 175	-2.5	W. 97	+0.4	E. 26	+5.9	W. 13	+8.0
	23	W. 117	-0.3	E. 164	-2.5	W. 106	+0.4	E. 17	+5.9	W. 22	+8.0
Apr.	2	W. 125	-0.6	E. 153	-2.4	W. 116	+0.3	E. 7	+5.9	W. 32	+8.0
May	12	W. 134	-0.9	E. 142	-2.4	W. 126	+0.3	W. 2	+5.9	W. 42	+7.9
	22	W. 144	-1.2	E. 131	-2.3	W. 136	+0.2	W. 11	+5.9	W. 51	+7.9
	2	W. 154	-1.5	E. 121	-2.3	W. 147	+0.2	W. 20	+5.9	W. 60	+7.9
	12	W. 166	-1.8	E. 112	-2.2	W. 157	+0.1	W. 29	+5.9	W. 70	+7.9
June	22	W. 179	-2.1	E. 102	-2.1	W. 167	+0.1	W. 39	+5.9	W. 79	+7.9
	1	E. 167	-2.0	E. 93	-2.1	W. 177	0.0	W. 48	+5.9	W. 89	+7.9
	11	E. 155	-1.8	E. 84	-2.0	E. 172	0.0	W. 57	+5.9	W. 98	+7.9
July	21	E. 143	-1.6	E. 76	-1.9	E. 162	+0.1	W. 66	+5.9	W. 108	+7.9
	1	E. 133	-1.4	E. 67	-1.9	E. 152	+0.2	W. 75	+5.8	W. 118	+7.9
Aug.	11	E. 125	-1.2	E. 59	-1.8	E. 141	+0.2	W. 85	+5.8	W. 127	+7.8
	21	E. 117	-1.0	E. 51	-1.8	E. 132	+0.3	W. 94	+5.8	W. 137	+7.8
	31	E. 111	-0.8	E. 44	-1.7	E. 122	+0.3	W. 104	+5.8	W. 147	+7.8
	10	E. 105	-0.6	E. 36	-1.7	E. 112	+0.4	W. 113	+5.8	W. 157	+7.8
	20	E. 100	-0.5	E. 28	-1.7	E. 102	+0.4	W. 123	+5.8	W. 166	+7.8
Sept.	30	E. 96	-0.3	E. 21	-1.7	E. 93	+0.5	W. 133	+5.7	W. 176	+7.8
	9	E. 92	-0.2	E. 13	-1.7	E. 84	+0.5	W. 143	+5.7	E. 174	+7.8
	19	E. 88	-0.1	E. 6	-1.7	E. 74	+0.5	W. 153	+5.7	E. 164	+7.8
Oct.	29	E. 85	0.0	W. 2	-1.7	E. 65	+0.5	W. 163	+5.7	E. 154	+7.8
	9	E. 82	+0.1	W. 10	-1.7	E. 56	+0.5	W. 173	+5.7	E. 144	+7.8
Nov.	19	E. 79	+0.2	W. 18	-1.7	E. 47	+0.5	E. 176	+5.7	E. 133	+7.8
	29	E. 76	+0.3	W. 25	-1.7	E. 38	+0.5	E. 166	+5.7	E. 123	+7.9
	8	E. 73	+0.4	W. 33	-1.7	E. 29	+0.5	E. 156	+5.7	E. 113	+7.9
	18	E. 70	+0.5	W. 42	-1.7	E. 20	+0.5	E. 145	+5.7	E. 103	+7.9
	28	E. 68	+0.6	W. 50	-1.8	E. 11	+0.5	E. 135	+5.7	E. 93	+7.9
Dec.	8	E. 65	+0.7	W. 58	-1.8	E. 3	+0.4	E. 124	+5.7	E. 83	+7.9
	18	E. 62	+0.8	W. 67	-1.9	W. 7	+0.5	E. 114	+5.8	E. 73	+7.9
	28	E. 60	+0.9	W. 76	-1.9	W. 16	+0.5	E. 104	+5.8	E. 63	+7.9
	38	E. 57	+0.9	W. 85	-2.0	W. 25	+0.5	E. 94	+5.8	E. 53	+7.9

VISUAL MAGNITUDES OF SELECTED DWARF & MINOR PLANETS

	Jan. 3	Feb. 12	Mar. 23	May 2	June 11	July 21	Aug. 30	Oct. 9	Nov. 18	Dec. 28
Ceres	9.3	9.1	9.1	9.3	9.2	8.9	8.4	7.6	7.9	8.5
Pallas	10.5	10.5	10.6	10.5	10.1	9.6	9.2	9.7	10.2	10.3
Juno	11.2	10.9	10.4	10.0	10.6	11.2	11.5	11.5	11.4	11.4
Vesta	8.0	8.3	8.4	8.3	8.3	8.5	8.4	8.1	7.6	6.7
Pluto	14.2	14.2	14.2	14.2	14.1	14.1	14.2	14.2	14.2	14.3

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h		d	h	
Jan.	2	06	LAST QUARTER	Mar.	14	14 <i>Aldebaran</i> 0°3 S. of Moon Occn.
	2	12	Moon at apogee		15	17 FIRST QUARTER
	2	23	Earth at perihelion		20	05 Equinox
	3	19	Mars 1°5 S. of Moon		20	14 Venus 0°5 S. of Neptune
	5	05	Mercury stationary		22	04 Jupiter 2° N. of Moon
	6	03	Pluto in conjunction with Sun		23	12 FULL MOON Penumbra Eclipse
	6	17	Venus 6° N. of <i>Antares</i>		23	20 Mercury in superior conjunction
	7	00	Venus 3° S. of Moon		25	13 Saturn stationary
	7	05	Saturn 3° S. of Moon		25	14 Moon at apogee
	8	20	Jupiter stationary		28	19 Mars 4° S. of Moon
	9	04	Venus 0°09 N. of Saturn		29	15 Saturn 3° S. of Moon
	10	02	NEW MOON		31	15 LAST QUARTER
	13	15	Neptune 2° S. of Moon	Apr.	5	01 Neptune 1°9 S. of Moon
	14	14	Mercury in inferior conjunction		6	08 Venus 0°7 S. of Moon Occn.
	15	02	Moon at perigee		7	11 NEW MOON
	16	06	Uranus 1°5 N. of Moon		7	18 Moon at perigee
	16	23	FIRST QUARTER		8	11 Mercury 5° N. of Moon
	19	10	Pallas in conjunction with Sun		9	04 Vesta 0°02 S. of Moon Occn.
	20	03	<i>Aldebaran</i> 0°5 S. of Moon Occn.		9	21 Uranus in conjunction with Sun
	24	02	FULL MOON		10	22 <i>Aldebaran</i> 0°3 S. of Moon Occn.
	25	19	Mercury stationary		14	04 FIRST QUARTER
	28	01	Jupiter 1°4 N. of Moon		17	02 Mars stationary
	30	09	Moon at apogee		18	05 Jupiter 2° N. of Moon
Feb.	1	03	LAST QUARTER		18	13 Pluto stationary
	1	09	Mars 3° S. of Moon		18	14 Mercury greatest elong. E. (20°)
	3	19	Saturn 3° S. of Moon		21	16 Moon at apogee
	6	08	Venus 4° S. of Moon		22	05 FULL MOON
	6	17	Mercury 4° S. of Moon		25	04 Mars 5° S. of Moon
	7	01	Mercury greatest elong. W. (26°)		25	19 Saturn 3° S. of Moon
	8	15	NEW MOON		27	03 Juno at opposition
	10	00	Neptune 2° S. of Moon		29	04 Mercury stationary
	11	03	Moon at perigee		30	03 LAST QUARTER
	12	14	Uranus 1°7 N. of Moon	May	2	11 Neptune 1°7 S. of Moon
	15	08	FIRST QUARTER		5	03 Uranus 2° N. of Moon
	16	08	<i>Aldebaran</i> 0°3 S. of Moon Occn.		6	04 Moon at perigee
	22	18	FULL MOON		6	19 NEW MOON
	24	04	Jupiter 1°7 N. of Moon		8	09 <i>Aldebaran</i> 0°5 S. of Moon Occn.
	27	03	Moon at apogee		9	15 Mercury in inferior conjunction, transit over Sun
	28	16	Neptune in conjunction with Sun		9	23 Jupiter stationary
	29	18	Mars 4° S. of Moon		13	17 FIRST QUARTER
Mar.	1	23	LAST QUARTER		15	10 Jupiter 2° N. of Moon
	2	07	Saturn 4° S. of Moon		18	22 Moon at apogee
	3	22	Ceres in conjunction with Sun		21	20 Mars 6° S. of Moon
	6	16	Juno stationary		21	21 FULL MOON
	7	11	Venus 4° S. of Moon		21	22 Mercury stationary
	8	11	Jupiter at opposition		22	11 Mars at opposition
	9	02	NEW MOON Eclipse		22	22 Saturn 3° S. of Moon
	10	07	Moon at perigee			
	11	01	Uranus 1°9 N. of Moon			

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h			d	h		
May	23	19	Vesta in conjunction with Sun		Aug.	4	22	Mercury 0°6' N. of Moon Occn.
	29	12	LAST QUARTER			5	09	Venus 1°1' N. of <i>Regulus</i>
	29	19	Neptune 1°4' S. of Moon			6	04	Jupiter 0°2' N. of Moon Occn.
	30	22	Mars closest approach			10	00	Moon at apogee
June	1	14	Uranus 2° N. of Moon			10	18	FIRST QUARTER
	3	07	Saturn at opposition			11	22	Mars 8° S. of Moon
	3	10	Mercury 0°7' N. of Moon Occn.			12	12	Saturn 4° S. of Moon
	3	11	Moon at perigee			13	18	Saturn stationary
	5	03	NEW MOON			16	21	Mercury greatest elong. E. (27°)
	5	09	Mercury greatest elong. W. (24°)			18	09	FULL MOON Penumbral Eclipse
	6	22	Venus in superior conjunction			19	12	Neptune 1°1' S. of Moon Occn.
	11	20	Jupiter 1°5' N. of Moon			20	12	Pallas at opposition
	12	08	FIRST QUARTER			22	01	Moon at perigee
	14	08	Neptune stationary			22	10	Uranus 3° N. of Moon
	15	12	Moon at apogee			24	04	Mars 1°8' N. of <i>Antares</i>
	17	10	Mars 7° S. of Moon			25	04	LAST QUARTER
	18	15	Pallas stationary			25	17	<i>Aldebaran</i> 0°2' S. of Moon Occn.
	19	00	Saturn 3° S. of Moon			25	18	Mars 4° S. of Saturn
	19	21	Mercury 4° N. of <i>Aldebaran</i>			27	05	Mercury 5° S. of Venus
	20	11	FULL MOON			27	22	Venus 0°07' N. of Jupiter
	20	23	Solstice			30	01	Mercury stationary
	25	17	Juno stationary		Sept.	1	09	NEW MOON Eclipse
	26	01	Neptune 1°2' S. of Moon Occn.			2	13	Ceres stationary
	27	18	LAST QUARTER			2	17	Mercury 6° S. of Moon
	28	23	Uranus 3° N. of Moon			2	17	Neptune at opposition
	30	08	Mars stationary			2	22	Jupiter 0°4' S. of Moon Occn.
July	1	07	Moon at perigee			3	11	Venus 1°1' S. of Moon Occn.
	2	04	<i>Aldebaran</i> 0°4' S. of Moon Occn.			6	19	Moon at apogee
	4	11	NEW MOON			8	21	Saturn 4° S. of Moon
	4	16	Earth at aphelion			9	12	FIRST QUARTER
	7	03	Mercury in superior conjunction			9	14	Mars 8° S. of Moon
	7	22	Pluto at opposition			13	00	Mercury in inferior conjunction
	9	10	Jupiter 0°9' N. of Moon Occn.			15	20	Neptune 1°2' S. of Moon Occn.
	12	01	FIRST QUARTER			16	19	FULL MOON Penumbral Eclipse
	13	05	Moon at apogee			17	23	Venus 3° N. of <i>Spica</i>
	14	18	Mars 8° S. of Moon			18	17	Moon at perigee
	16	05	Saturn 3° S. of Moon			18	17	Uranus 3° N. of Moon
	16	18	Mercury 0°5' N. of Venus			21	10	Mercury stationary
	19	23	FULL MOON			21	23	<i>Aldebaran</i> 0°2' S. of Moon Occn.
	23	06	Neptune 1°1' S. of Moon Occn.			22	14	Equinox
	26	04	Uranus 3° N. of Moon			23	10	LAST QUARTER
	26	23	LAST QUARTER			26	03	Pluto stationary
	27	12	Moon at perigee			26	07	Jupiter in conjunction with Sun
	29	11	<i>Aldebaran</i> 0°3' S. of Moon Occn.			28	20	Mercury greatest elong. W. (18°)
	30	02	Uranus stationary			29	11	Mercury 0°7' N. of Moon Occn.
	30	17	Mercury 0°3' N. of <i>Regulus</i>		Oct.	1	00	NEW MOON
Aug.	2	21	NEW MOON			3	17	Venus 5° S. of Moon
	4	06	Venus 3° N. of Moon			4	11	Moon at apogee
						6	08	Saturn 4° S. of Moon
						8	02	Pallas stationary
						8	12	Mars 7° S. of Moon

CONFIGURATIONS OF SUN, MOON AND PLANETS

Oct.	d h		Nov.	d h	
	9 05	FIRST QUARTER		21 09	LAST QUARTER
	11 04	Mercury 0°9 N. of Jupiter		25 02	Jupiter 1°9 S. of Moon
	13 06	Neptune 1°2 S. of Moon Occn.		27 20	Moon at apogee
	15 11	Uranus at opposition		29 12	NEW MOON
	16 02	Uranus 3° N. of Moon		29 20	Juno in conjunction with Sun
	16 04	FULL MOON	Dec.	1 04	Mercury 7° S. of Moon
	17 00	Moon at perigee		3 04	Vesta stationary
	19 07	Aldebaran 0°3 S. of Moon Occn.		3 13	Venus 6° S. of Moon
	21 05	Ceres at opposition		5 11	Mars 3° S. of Moon
	22 19	LAST QUARTER		6 22	Neptune 0°7 S. of Moon Occn.
	26 04	Venus 3° N. of Antares		7 09	FIRST QUARTER
	27 16	Mercury in superior conjunction		9 20	Uranus 3° N. of Moon
	28 10	Jupiter 1°4 S. of Moon		10 12	Saturn in conjunction with Sun
	30 08	Venus 3° S. of Saturn		11 05	Mercury greatest elong. E. (21°)
	30 18	NEW MOON		12 23	Moon at perigee
	31 19	Moon at apogee		13 05	Aldebaran 0°5 S. of Moon Occn.
Nov.	2 19	Saturn 4° S. of Moon		14 00	FULL MOON
	3 04	Venus 7° S. of Moon		15 07	Ceres stationary
	6 12	Mars 5° S. of Moon		18 19	Regulus 1°0 N. of Moon Occn.
	7 20	FIRST QUARTER		19 07	Mercury stationary
	9 15	Neptune 1°0 S. of Moon Occn.		21 02	LAST QUARTER
	12 11	Uranus 3° N. of Moon		21 11	Solstice
	14 11	Moon at perigee		22 17	Jupiter 2° S. of Moon
	14 14	FULL MOON		25 06	Moon at apogee
	15 17	Aldebaran 0°4 S. of Moon Occn.		27 21	Saturn 4° S. of Moon
	18 21	Mercury 3° N. of Antares		28 19	Mercury in inferior conjunction
	20 10	Neptune stationary		29 07	NEW MOON
				29 16	Uranus stationary

PREDICTED PERIHELION PASSAGES OF COMETS, 2016

Periodic comet	Perihelion date	distance <i>T</i>	Period <i>q</i> (au) <i>P</i> (yr)	Periodic comet	Perihelion date	distance <i>T</i>	Period <i>q</i> (au) <i>P</i> (yr)
116P/Wild	Jan. 12	2.18	6.49	146P/Shoemaker-LINEAR	June 29	1.42	8.11
211P/Hill	Jan. 27	2.35	6.72	207P/NEAT	June 30	0.93	7.64
50P/Arend	Feb. 7	1.91	8.26	208P/McMillan	July 1	2.53	8.14
147P/Kushida-Muramatsu	Feb. 26	2.74	7.42	279P/La Sagra	July 14	2.15	6.76
194P/LINEAR	Mar. 2	1.70	8.01	56P/Slaughter-Burnham	July 17	2.50	11.5
127P/Holt-Olmstead	Mar. 17	2.20	6.40	P/2009 K1 (Gibbs)	July 25	1.34	7.09
104P/Kowal	Mar. 25	1.17	5.89	150P/LONEOS	July 25	1.76	7.66
100P/Hartley	Apr. 2	2.00	6.33	225P/LINEAR	Aug. 16	1.32	6.98
190P/Mueller	Apr. 7	2.03	8.74	33P/Daniel	Aug. 21	2.16	8.08
53P/Van Biesbroeck	Apr. 30	2.43	12.6	P/1999 V1 (Catalina)	Aug. 30	2.95	16.9
77P/Longmore	May 14	2.33	6.86	144P/Kushida	Aug. 30	1.43	7.59
224P/LINEAR-NEAT	May 23	1.99	6.31	226P/Pigott-LINEAR-Kowalski	Sept. 4	1.77	7.32
P/2007 R3 (Gibbs)	May 27	2.51	8.90	212P/NEAT	Sept. 1	1.64	7.77
136P/Mueller	May 31	2.97	8.61	P/1997 G1 (Montani)	Oct. 7	4.24	19.6
216P/LINEAR	May 31	2.15	7.64	P/2005 S3 (Read)	Oct. 31	2.81	10.8
157P/Tritton	June 9	1.35	6.30	P/2008 T1 (Boattini)	Nov. 19	3.05	8.74
202P/Scotti	June 10	2.52	7.33	P/2008 J3 (McNaught)	Nov. 22	2.29	7.70
118P/Shoemaker-Levy	June 16	1.98	6.45	P/2004 VR8 (LONEOS)	Dec. 7	2.42	11.3

CHRONOLOGICAL CYCLES AND ERAS

Dominical Letter	... .. CB	Julian Period (year of)	... .. 6729
Epact	... .. 21	Roman Indiction	... .. 9
Golden Number (Lunar Cycle)	... III	Solar Cycle	... .. 9

All dates are given in terms of the Gregorian calendar in which
2016 January 14 corresponds to 2016 January 1 of the Julian calendar.

ERA	YEAR	BEGINS	ERA	YEAR	BEGINS
Byzantine	... .. 7525	Sept. 14	Japanese	... .. 2676	Jan. 1
Jewish (A.M.)*	... .. 5777	Oct. 2	Seleucidæ (Grecian)	... 2328	Sept. 14
Chinese (bǐng shēn)	... ..	Feb. 8			(or Oct. 14)
Roman (A.U.C.)	... .. 2769	Jan. 14	Saka (Indian)	... .. 1938	Mar. 21
Nabonassar	... .. 2765	Apr. 19	Diocletian (Coptic)	... 1733	Sept. 11
			Islamic (Hegira)*	... 1438	Oct. 2

* Year begins at sunset

RELIGIOUS CALENDARS

Epiphany	... .. Jan. 6	Ascension Day	... .. May 5
Ash Wednesday	... .. Feb. 10	Whit Sunday—Pentecost	... May 15
Palm Sunday	... .. Mar. 20	Trinity Sunday	... .. May 22
Good Friday	... .. Mar. 25	First Sunday in Advent	... .. Nov. 27
Easter Day	... .. Mar. 27	Christmas Day (Sunday)	... .. Dec. 25
First Day of Passover (Pesach)	Apr. 23	Day of Atonement (Yom Kippur)	Oct. 12
Feast of Weeks (Shavuot)	... June 12	First day of Tabernacles	
Jewish New Year‡		(Succoth)	... .. Oct. 17
(Rosh Hashanah)	... .. Oct. 3	Festival of Lights (Hanukkah)	Dec. 25
First day of Ramadân‡	... .. June 7	Islamic New Year‡	... .. Oct. 3
First day of Shawwal‡	... .. July 7		

‡The Jewish and Islamic dates above are tabular dates, which begin at sunset on the previous evening and end at sunset on the date tabulated. In practice, the dates of Islamic fasts and festivals are determined by an actual sighting of the appropriate new Moon.

CIVIL CALENDAR—UNITED STATES OF AMERICA

New Year's Day	... .. Jan. 1	Labor Day	... .. Sept. 5
Martin Luther King's Birthday	Jan. 18	Columbus Day	... .. Oct. 10
Washington's Birthday	... .. Feb. 15	General Election Day	... .. Nov. 8
Memorial Day	... .. May 30	Veterans Day	... .. Nov. 11
Independence Day	... .. July 4	Thanksgiving Day	... .. Nov. 24

CIVIL CALENDAR—UNITED KINGDOM

Accession of Queen Elizabeth II	Feb. 6	Birthday of Prince Philip,	
St David (Wales)	... .. Mar. 1	Duke of Edinburgh	... .. June 10
Commonwealth Day	... .. Mar. 14	The Queen's Official Birthday†	June 11
St Patrick (Ireland)	... .. Mar. 17	Remembrance Sunday	... .. Nov. 13
Birthday of Queen Elizabeth II	Apr. 21	Birthday of the Prince of Wales	Nov. 14
St George (England)	... .. Apr. 23	St Andrew (Scotland)	... .. Nov. 30
Coronation Day	... .. June 2		

†Date subject to confirmation

JANUARY			FEBRUARY		MARCH		APRIL		MAY		JUNE	
Day of Month	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year
1	Fri.	1	Mon.	32	Tue.	61	Fri.	92	Sun.	122	Wed.	153
2	Sat.	2	Tue.	33	Wed.	62	Sat.	93	Mon.	123	Thu.	154
3	Sun.	3	Wed.	34	Thu.	63	Sun.	94	Tue.	124	Fri.	155
4	Mon.	4	Thu.	35	Fri.	64	Mon.	95	Wed.	125	Sat.	156
5	Tue.	5	Fri.	36	Sat.	65	Tue.	96	Thu.	126	Sun.	157
6	Wed.	6	Sat.	37	Sun.	66	Wed.	97	Fri.	127	Mon.	158
7	Thu.	7	Sun.	38	Mon.	67	Thu.	98	Sat.	128	Tue.	159
8	Fri.	8	Mon.	39	Tue.	68	Fri.	99	Sun.	129	Wed.	160
9	Sat.	9	Tue.	40	Wed.	69	Sat.	100	Mon.	130	Thu.	161
10	Sun.	10	Wed.	41	Thu.	70	Sun.	101	Tue.	131	Fri.	162
11	Mon.	11	Thu.	42	Fri.	71	Mon.	102	Wed.	132	Sat.	163
12	Tue.	12	Fri.	43	Sat.	72	Tue.	103	Thu.	133	Sun.	164
13	Wed.	13	Sat.	44	Sun.	73	Wed.	104	Fri.	134	Mon.	165
14	Thu.	14	Sun.	45	Mon.	74	Thu.	105	Sat.	135	Tue.	166
15	Fri.	15	Mon.	46	Tue.	75	Fri.	106	Sun.	136	Wed.	167
16	Sat.	16	Tue.	47	Wed.	76	Sat.	107	Mon.	137	Thu.	168
17	Sun.	17	Wed.	48	Thu.	77	Sun.	108	Tue.	138	Fri.	169
18	Mon.	18	Thu.	49	Fri.	78	Mon.	109	Wed.	139	Sat.	170
19	Tue.	19	Fri.	50	Sat.	79	Tue.	110	Thu.	140	Sun.	171
20	Wed.	20	Sat.	51	Sun.	80	Wed.	111	Fri.	141	Mon.	172
21	Thu.	21	Sun.	52	Mon.	81	Thu.	112	Sat.	142	Tue.	173
22	Fri.	22	Mon.	53	Tue.	82	Fri.	113	Sun.	143	Wed.	174
23	Sat.	23	Tue.	54	Wed.	83	Sat.	114	Mon.	144	Thu.	175
24	Sun.	24	Wed.	55	Thu.	84	Sun.	115	Tue.	145	Fri.	176
25	Mon.	25	Thu.	56	Fri.	85	Mon.	116	Wed.	146	Sat.	177
26	Tue.	26	Fri.	57	Sat.	86	Tue.	117	Thu.	147	Sun.	178
27	Wed.	27	Sat.	58	Sun.	87	Wed.	118	Fri.	148	Mon.	179
28	Thu.	28	Sun.	59	Mon.	88	Thu.	119	Sat.	149	Tue.	180
29	Fri.	29	Mon.	60	Tue.	89	Fri.	120	Sun.	150	Wed.	181
30	Sat.	30			Wed.	90	Sat.	121	Mon.	151	Thu.	182
31	Sun.	31			Thu.	91			Tue.	152		

JULIAN DATE, 2016

0 ^h UT	JD	0 ^h UT	JD	0 ^h UT	JD
Jan. 0	245 7387.5	May 0	245 7508.5	Sept. 0	245 7631.5
Feb. 0	245 7418.5	June 0	245 7539.5	Oct. 0	245 7661.5
Mar. 0	245 7447.5	July 0	245 7569.5	Nov. 0	245 7692.5
Apr. 0	245 7478.5	Aug. 0	245 7600.5	Dec. 0	245 7722.5

400-day date, JD 245 7600.5 = 2016 July 31.0

Standard epoch, 1900 January 0, 12^h UT = JD 241 5020.0
Standard epoch, B1950.0 = 1950 Jan. 0.923 = JD 243 3282.423
B2016.0 = 2016 Jan. 0.909 = JD 245 7388.409

Standard epoch, J2000.0 = 2000 Jan. 1.5 = JD 245 1545.0
J2016.5 = 2016 July 2.125 = JD 245 7571.625

	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
Day of Month	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year
1	Fri.	183	Mon.	214	Thu.	245	Sat.	275	Tue.	306	Thu.	336
2	Sat.	184	Tue.	215	Fri.	246	Sun.	276	Wed.	307	Fri.	337
3	Sun.	185	Wed.	216	Sat.	247	Mon.	277	Thu.	308	Sat.	338
4	Mon.	186	Thu.	217	Sun.	248	Tue.	278	Fri.	309	Sun.	339
5	Tue.	187	Fri.	218	Mon.	249	Wed.	279	Sat.	310	Mon.	340
6	Wed.	188	Sat.	219	Tue.	250	Thu.	280	Sun.	311	Tue.	341
7	Thu.	189	Sun.	220	Wed.	251	Fri.	281	Mon.	312	Wed.	342
8	Fri.	190	Mon.	221	Thu.	252	Sat.	282	Tue.	313	Thu.	343
9	Sat.	191	Tue.	222	Fri.	253	Sun.	283	Wed.	314	Fri.	344
10	Sun.	192	Wed.	223	Sat.	254	Mon.	284	Thu.	315	Sat.	345
11	Mon.	193	Thu.	224	Sun.	255	Tue.	285	Fri.	316	Sun.	346
12	Tue.	194	Fri.	225	Mon.	256	Wed.	286	Sat.	317	Mon.	347
13	Wed.	195	Sat.	226	Tue.	257	Thu.	287	Sun.	318	Tue.	348
14	Thu.	196	Sun.	227	Wed.	258	Fri.	288	Mon.	319	Wed.	349
15	Fri.	197	Mon.	228	Thu.	259	Sat.	289	Tue.	320	Thu.	350
16	Sat.	198	Tue.	229	Fri.	260	Sun.	290	Wed.	321	Fri.	351
17	Sun.	199	Wed.	230	Sat.	261	Mon.	291	Thu.	322	Sat.	352
18	Mon.	200	Thu.	231	Sun.	262	Tue.	292	Fri.	323	Sun.	353
19	Tue.	201	Fri.	232	Mon.	263	Wed.	293	Sat.	324	Mon.	354
20	Wed.	202	Sat.	233	Tue.	264	Thu.	294	Sun.	325	Tue.	355
21	Thu.	203	Sun.	234	Wed.	265	Fri.	295	Mon.	326	Wed.	356
22	Fri.	204	Mon.	235	Thu.	266	Sat.	296	Tue.	327	Thu.	357
23	Sat.	205	Tue.	236	Fri.	267	Sun.	297	Wed.	328	Fri.	358
24	Sun.	206	Wed.	237	Sat.	268	Mon.	298	Thu.	329	Sat.	359
25	Mon.	207	Thu.	238	Sun.	269	Tue.	299	Fri.	330	Sun.	360
26	Tue.	208	Fri.	239	Mon.	270	Wed.	300	Sat.	331	Mon.	361
27	Wed.	209	Sat.	240	Tue.	271	Thu.	301	Sun.	332	Tue.	362
28	Thu.	210	Sun.	241	Wed.	272	Fri.	302	Mon.	333	Wed.	363
29	Fri.	211	Mon.	242	Thu.	273	Sat.	303	Tue.	334	Thu.	364
30	Sat.	212	Tue.	243	Fri.	274	Sun.	304	Wed.	335	Fri.	365
31	Sun.	213	Wed.	244			Mon.	305			Sat.	366

MEAN SIDEREAL TIME, 2016

Greenwich mean sidereal time at 0^h UT

Jan. 0	^h 6:6070	Apr. 0	^h 12:5866	July 0	^h 18:5662	Oct. 0	^h 0:6115
Feb. 0	8:6440	May 0	14:5579	Aug. 0	20:6032	Nov. 0	2:6485
Mar. 0	10:5496	June 0	16:5949	Sept. 0	22:6402	Dec. 0	4:6198

Greenwich mean sidereal time (GMST) on day d of month at hour t UT

$$= \text{GMST at } 0^{\text{h}} \text{ UT on day } 0 + 0^{\text{h}}065\,71\,d + 1^{\text{h}}002\,74\,t$$

$$\text{Local mean sidereal time} = \text{GMST} \begin{matrix} + \text{east} \\ - \text{west} \end{matrix} \text{ longitude}$$

AT 0^h UNIVERSAL TIME

Equation Date	Declin- of time	ation	Equation Date	Declin- of time	ation	Equation Date	Declin- of time	ation	Equation Date	Declin- of time	ation
Jan. 0	^m -02 36	^s -23 08	Feb. 15	^m -14 10	^s -12 57	Apr. 1	^m -03 53	^s +04 37	May 17	^m +03 37	^s +19 22
1	03 04	23 04	16	14 07	12 36	2	03 35	05 01	18	03 35	19 36
2	03 33	22 59	17	14 04	12 15	3	03 17	05 24	19	03 32	19 49
3	04 01	22 53	18	14 00	11 54	4	03 00	05 46	20	03 29	20 01
4	04 29	22 48	19	13 55	11 33	5	02 43	06 09	21	03 25	20 14
5	-04 56	-22 42	20	-13 49	-11 12	6	-02 26	+06 32	22	+03 21	+20 25
6	05 23	22 35	21	13 43	10 50	7	02 09	06 55	23	03 16	20 37
7	05 50	22 28	22	13 36	10 29	8	01 52	07 17	24	03 11	20 48
8	06 16	22 20	23	13 29	10 07	9	01 36	07 39	25	03 05	20 59
9	06 41	22 12	24	13 20	09 45	10	01 20	08 02	26	02 59	21 10
10	-07 06	-22 04	25	-13 12	-09 23	11	-01 04	+08 24	27	+02 52	+21 20
11	07 31	21 55	26	13 02	09 01	12	00 48	08 46	28	02 45	21 29
12	07 55	21 46	27	12 53	08 38	13	00 33	09 07	29	02 37	21 39
13	08 18	21 36	28	12 42	08 16	14	00 18	09 29	30	02 29	21 48
14	08 41	21 26	29	12 31	07 53	15	-00 03	09 51	31	02 20	21 56
15	-09 03	-21 16	Mar. 1	-12 20	-07 30	16	+00 11	+10 12	June 1	+02 11	+22.05
16	09 25	21 05	2	12 08	07 07	17	00 25	10 33	2	02 02	22 13
17	09 45	20 53	3	11 55	06 44	18	00 39	10 54	3	01 52	22 20
18	10 05	20 42	4	11 42	06 21	19	00 52	11 15	4	01 42	22 27
19	10 25	20 30	5	11 29	05 58	20	01 05	11 35	5	01 31	22 34
20	-10 43	-20 17	6	-11 15	-05 35	21	+01 17	+11 56	6	+01 20	+22 40
21	11 01	20 04	7	11 01	05 12	22	01 29	12 16	7	01 09	22 46
22	11 18	19 51	8	10 47	04 48	23	01 40	12 36	8	00 58	22 52
23	11 34	19 37	9	10 32	04 25	24	01 51	12 56	9	00 46	22 57
24	11 50	19 23	10	10 17	04 01	25	02 02	13 16	10	00 34	23 01
25	-12 04	-19 09	11	-10 01	-03 38	26	+02 12	+13 35	11	+00 22	+23 06
26	12 18	18 54	12	09 46	03 14	27	02 22	13 54	12	+00 10	23 10
27	12 31	18 39	13	09 29	02 50	28	02 31	14 13	13	-00 03	23 13
28	12 44	18 24	14	09 13	02 27	29	02 39	14 32	14	00 16	23 16
29	12 55	18 08	15	08 56	02 03	30	02 47	14 50	15	00 28	23 19
30	-13 06	-17 52	16	-08 39	-01 39	May 1	+02 55	+15 08	16	-00 41	+23 21
31	13 16	17 36	17	08 22	01 16	2	03 01	15 26	17	00 54	23 23
Feb. 1	13 25	17 19	18	08 05	00 52	3	03 08	15 44	18	01 07	23 24
2	13 33	17 02	19	07 47	00 28	4	03 13	16 02	19	01 20	23 25
3	13 41	16 45	20	07 29	-00 04	5	03 19	16 19	20	01 33	23 26
4	-13 48	-16 27	21	-07 12	+00 19	6	+03 23	+16 36	21	-01 46	+23 26
5	13 54	16 09	22	06 54	00 43	7	03 27	16 52	22	01 59	23 26
6	13 59	15 51	23	06 35	01 07	8	03 31	17 09	23	02 12	23 25
7	14 03	15 33	24	06 17	01 30	9	03 33	17 25	24	02 24	23 24
8	14 07	15 14	25	05 59	01 54	10	03 36	17 41	25	02 37	23 23
9	-14 09	-14 55	26	-05 41	+02 17	11	+03 38	+17 56	26	-02 50	+23 21
10	14 11	14 36	27	05 23	02 41	12	03 39	18 11	27	03 02	23 19
11	14 13	14 17	28	05 05	03 04	13	03 39	18 26	28	03 14	23 16
12	14 13	13 57	29	04 46	03 28	14	03 40	18 41	29	03 27	23 13
13	14 13	13 37	30	04 28	03 51	15	03 39	18 55	30	03 39	23 09
14	-14 12	-13 17	31	-04 10	+04 14	16	+03 38	+19 09	July 1	-03 50	+23 05
15	-14 10	-12 57	Apr. 1	-03 53	+04 37	17	+03 37	+19 22	2	-04 02	+23 01

Equation of time = apparent time - mean time

AT 0^h UNIVERSAL TIME

Equation Date	Declin- of time	ation	Equation Date	Declin- of time	ation	Equation Date	Declin- of time	ation	Equation Date	Declin- of time	ation
July	^m ^s	[°] [']	Aug. 16	^m ^s	[°] [']	Oct. 1	^m ^s	[°] [']	Nov. 16	^m ^s	[°] [']
1	-03 50	+23 05	17	-04 16	+13 40	2	+10 20	-03 16	17	+15 15	-18 47
2	04 02	23 01	18	04 04	13 21	3	10 40	03 39	18	15 03	19 02
3	04 13	22 56	19	03 50	13 01	4	10 58	04 03	19	14 51	19 16
4	04 24	22 51	20	03 37	12 42	5	11 17	04 26	20	14 38	19 30
5	04 35	22 46	21	03 22	12 22	6	11 35	04 49	21	14 24	19 44
6	-04 45	+22 40	22	-03 08	+12 02	7	+11 53	-05 12	22	+14 10	-19 57
7	04 55	22 33	23	02 52	11 42	8	12 10	05 35	23	13 54	20 10
8	05 04	22 27	24	02 37	11 22	9	12 27	05 58	24	13 38	20 23
9	05 13	22 20	25	02 21	11 01	10	12 44	06 21	25	13 21	20 35
10	05 22	22 12	26	02 04	10 41	11	13 00	06 43	26	13 03	20 47
11	-05 30	+22 04	27	-01 48	+10 20	12	+13 15	-07 06	27	+12 44	-20 58
12	05 38	21 56	28	01 31	09 59	13	13 31	07 29	28	12 25	21 09
13	05 45	21 47	29	01 13	09 38	14	13 45	07 51	29	12 04	21 20
14	05 52	21 38	30	00 55	09 17	15	14 00	08 13	30	11 44	21 30
15	05 58	21 29	31	00 37	08 55	16	14 13	08 36	31	11 22	21 40
16	-06 04	+21 19	Sept. 1	-00 18	+08 34	17	+14 26	-08 58	Dec. 1	+11 00	-21 50
17	06 09	21 09	2	00 00	08 12	18	14 39	09 20	2	10 37	21 59
18	06 13	20 59	3	+00 19	07 50	19	14 51	09 41	3	10 13	22 07
19	06 18	20 48	4	00 39	07 28	20	15 02	10 03	4	09 49	22 16
20	06 21	20 37	5	00 59	07 06	21	15 13	10 25	5	09 25	22 23
21	-06 24	+20 25	6	+01 18	+06 44	22	+15 23	-10 46	6	+09 00	-22 31
22	06 26	20 14	7	01 39	06 21	23	15 32	11 07	7	08 34	22 38
23	06 28	20 01	8	01 59	05 59	24	15 41	11 28	8	08 08	22 44
24	06 30	19 49	9	02 19	05 37	25	15 49	11 49	9	07 41	22 50
25	06 30	19 36	10	02 40	05 14	26	15 56	12 10	10	07 14	22 55
26	-06 30	+19 23	11	+03 01	+04 51	27	+16 02	-12 31	11	+06 47	-23 01
27	06 30	19 09	12	03 22	04 28	28	16 08	12 51	12	06 19	23 05
28	06 29	18 56	13	03 43	04 06	29	16 13	13 11	13	05 51	23 09
29	06 27	18 42	14	04 05	03 43	30	16 17	13 31	14	05 23	23 13
30	06 25	18 27	15	04 26	03 20	31	16 21	13 51	15	04 54	23 16
31	-06 22	+18 12	16	+04 48	+02 57	Nov. 1	+16 23	-14 10	16	+04 25	-23 19
Aug. 1	06 19	17 57	17	05 09	02 33	2	16 25	14 30	17	03 56	23 21
2	06 15	17 42	18	05 31	02 10	3	16 26	14 49	18	03 27	23 23
3	06 10	17 26	19	05 52	01 47	4	16 26	15 07	19	02 57	23 25
4	06 05	17 11	20	06 14	01 24	5	16 26	15 26	20	02 28	23 26
5	-05 59	+16 54	21	+06 35	+01 01	6	+16 24	-15 44	21	+01 58	-23 26
6	05 53	16 38	22	06 56	00 37	7	16 22	16 02	22	01 28	23 26
7	05 46	16 21	23	07 17	+00 14	8	16 19	16 20	23	00 58	23 26
8	05 38	16 04	24	07 39	-00 09	9	16 15	16 38	24	+00 28	23 25
9	05 30	15 47	25	08 00	00 33	10	16 11	16 55	25	-00 02	23 23
10	-05 21	+15 30	26	+08 20	-00 56	11	+16 05	-17 12	26	-00 31	-23 21
11	05 12	15 12	27	08 41	01 19	12	15 59	17 28	27	01 01	23 19
12	05 02	14 54	28	09 01	01 43	13	15 52	17 45	28	01 31	23 16
13	04 51	14 36	29	09 21	02 06	14	15 44	18 01	29	02 00	23 13
14	04 40	14 17	30	09 41	02 30	15	15 35	18 17	30	02 29	23 09
15	-04 29	+13 59	Oct. 1	+10 01	-02 53	16	+15 25	-18 32	31	-02 58	-23 05
16	-04 16	+13 40	2	+10 20	-03 16	17	+15 15	-18 47	32	-03 26	-23 00

UT of transit = $12^{\text{h}} - \begin{matrix} \text{east} \\ + \text{west} \end{matrix}$ longitude - equation of time

AT 0^h UNIVERSAL TIME

Polaris			σ Oct			Polaris			σ Oct			Polaris			σ Oct								
Date	GHA	GHA	Date	GHA	GHA	Date	GHA	GHA	Date	GHA	GHA	Date	GHA	GHA	Date	GHA	GHA						
Jan. 0	55	46	138	55	Feb. 15	101	26	184	17	Apr. 1	147	04	229	29	May 17	192	26	274	37				
	1	56	46	139		54	16	102	26		185	16	2	148		03	230	28	18	193	25	275	35
	2	57	45	140		53	17	103	26		186	15	3	149		03	231	27	19	194	24	276	34
	3	58	45	141		53	18	104	25		187	14	4	150		02	232	26	20	195	23	277	33
	4	59	44	142		52	19	105	25		188	13	5	151		01	233	25	21	196	22	278	32
	5	60	44	143		51	20	106	24		189	12	6	152		01	234	24	22	197	20	279	31
	6	61	43	144		51	21	107	24		190	11	7	153		00	235	23	23	198	19	280	30
	7	62	43	145		50	22	108	24		191	10	8	153		59	236	21	24	199	18	281	29
	8	63	42	146		49	23	109	23		192	09	9	154		59	237	20	25	200	17	282	27
	9	64	42	147		48	24	110	23		193	08	10	155		58	238	19	26	201	16	283	26
	10	65	41	148		48	25	111	22		194	07	11	156		57	239	18	27	202	15	284	25
	11	66	41	149		47	26	112	22		195	06	12	157		56	240	17	28	203	14	285	24
	12	67	40	150		46	27	113	22		196	05	13	158		56	241	16	29	204	13	286	23
	13	68	40	151		45	28	114	21		197	04	14	159		55	242	15	30	205	12	287	22
14	69	39	152	44	29	115	21	198	03	15	160	54	243	14	31	206	11	288	20				
15	70	39	153	44	Mar. 1	116	20	199	02	16	161	53	244	12	June 1	207	10	289	19				
16	71	39	154	43		2	117	20	200	01	17	162	53	245		11	2	208	08	290	18		
17	72	38	155	42		3	118	19	201	00	18	163	52	246		10	3	209	07	291	17		
18	73	38	156	41		4	119	19	201	59	19	164	51	247		09	4	210	06	292	16		
19	74	37	157	41		5	120	18	202	58	20	165	50	248		08	5	211	05	293	15		
20	75	37	158	40		6	121	18	203	57	21	166	50	249		07	6	212	04	294	14		
21	76	36	159	39		7	122	17	204	56	22	167	49	250		06	7	213	02	295	12		
22	77	36	160	38		8	123	17	205	55	23	168	48	251		04	8	214	01	296	11		
23	78	35	161	37		9	124	17	206	54	24	169	47	252		03	9	215	00	297	10		
24	79	35	162	36		10	125	16	207	53	25	170	46	253		02	10	215	59	298	09		
25	80	35	163	35		11	126	16	208	52	26	171	45	254		01	11	216	58	299	08		
26	81	34	164	35		12	127	15	209	51	27	172	45	255		00	12	217	57	300	07		
27	82	34	165	34		13	128	15	210	50	28	173	44	255		59	13	218	55	301	06		
28	83	33	166	33		14	129	14	211	49	29	174	43	256		58	14	219	54	302	05		
29	84	33	167	32	15	130	14	212	48	30	175	42	257	56	15	220	53	303	03				
30	85	33	168	31	16	131	13	213	47	May 1	176	41	258	55	16	221	52	304	02				
31	86	32	169	30	17	132	12	214	46		2	177	40	259	54	17	222	51	305	01			
Feb. 1	87	32	170	30	18	133	12	215	45		3	178	39	260	53	18	223	49	306	00			
	2	88	32	171	29	19	134	11	216		43	4	179	38	261	52	19	224	48	306	59		
	3	89	31	172	28	20	135	11	217		42	5	180	38	262	51	20	225	47	307	58		
	4	90	31	173	27	21	136	10	218		41	6	181	37	263	49	21	226	45	308	57		
	5	91	30	174	26	22	137	10	219		40	7	182	36	264	48	22	227	44	309	56		
	6	92	30	175	25	23	138	09	220		39	8	183	35	265	47	23	228	43	310	55		
	7	93	29	176	24	24	139	09	221		38	9	184	34	266	46	24	229	42	311	53		
	8	94	29	177	23	25	140	08	222		37	10	185	33	267	45	25	230	40	312	52		
	9	95	29	178	22	26	141	08	223		36	11	186	32	268	44	26	231	39	313	51		
	10	96	28	179	21	27	142	07	224		35	12	187	31	269	42	27	232	38	314	50		
	11	97	28	180	20	28	143	06	225		34	13	188	30	270	41	28	233	37	315	49		
	12	98	28	181	20	29	144	06	226		33	14	189	29	271	40	29	234	36	316	48		
	13	99	27	182	19	30	145	05	227	32	15	190	28	272	39	30	235	34	317	47			
	14	100	27	183	18	31	146	04	228	30	16	191	27	273	38	July 1	236	33	318	46			
15	101	26	184	17	Apr. 1	147	04	229	29	17	192	26	274	37	2		237	32	319	45			

The dates between Jan. 0 and Dec. 32 below are the dates when p changes to the next value.

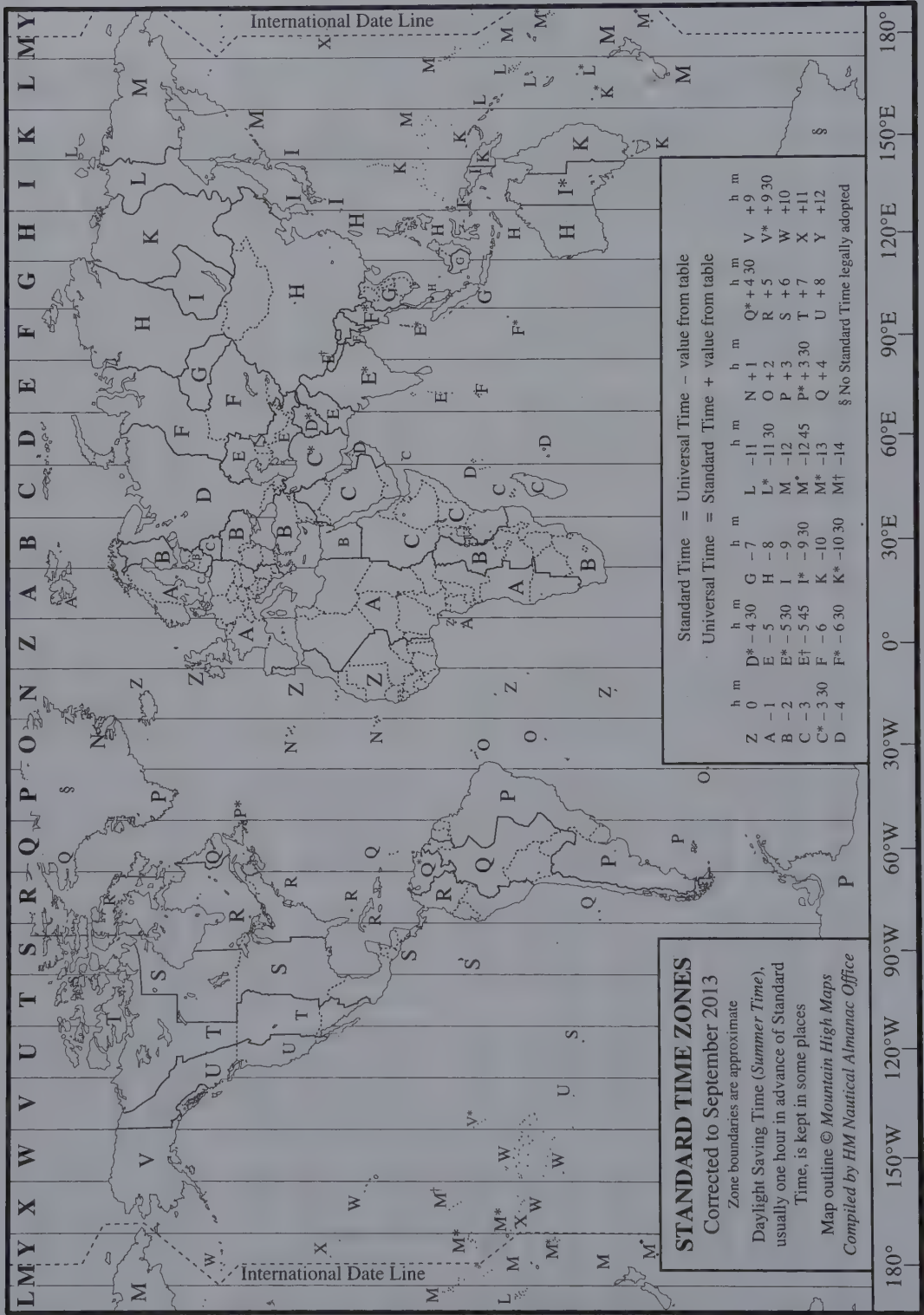
Polar Distance (p)	<i>Polaris</i> :	Jan. 0	40'	Dec. 32
	σ Octantis:	Jan. 0	67'	Dec. 32

AT 0^h UNIVERSAL TIME

Date	<i>Polaris</i> GHA	σ Oct GHA	Date	<i>Polaris</i> GHA	σ Oct GHA	Date	<i>Polaris</i> GHA	σ Oct GHA	Date	<i>Polaris</i> GHA	σ Oct GHA
July	1 236 33	318 46	Aug. 16	281 31	4 01	Oct. 1	326 32	49 26	Nov. 16	11 44	94 58
	2 237 32	319 45		17 282 30	5 00		2 327 31	50 25		17 12 43	95 57
	3 238 30	320 44		18 283 29	5 59		3 328 30	51 24		18 13 42	96 57
	4 239 29	321 43		19 284 27	6 58		4 329 29	52 24		19 14 42	97 56
	5 240 27	322 42		20 285 26	7 57		5 330 27	53 23		20 15 41	98 55
	6 241 26	323 40		21 286 25	8 56		6 331 26	54 22		21 16 40	99 55
	7 242 25	324 39		22 287 23	9 55		7 332 25	55 22		22 17 39	100 54
	8 243 24	325 38		23 288 22	10 55		8 333 24	56 21		23 18 38	101 54
	9 244 22	326 37		24 289 21	11 54		9 334 23	57 21		24 19 38	102 53
	10 245 21	327 36		25 290 19	12 53		10 335 22	58 20		25 20 37	103 52
	11 246 20	328 35		26 291 18	13 52		11 336 20	59 19		26 21 36	104 52
	12 247 18	329 34		27 292 16	14 51		12 337 19	60 19		27 22 35	105 51
	13 248 17	330 33		28 293 15	15 51		13 338 18	61 18		28 23 35	106 51
	14 249 16	331 32		29 294 14	16 50		14 339 17	62 17		29 24 34	107 50
	15 250 14	332 31		30 295 12	17 49		15 340 16	63 17		30 25 33	108 49
	16 251 13	333 30		31 296 11	18 48		16 341 15	64 16	Dec. 1	26 32	109 49
	17 252 12	334 29	Sept. 1	297 10	19 47		17 342 14	65 16		2 27 31	110 48
	18 253 10	335 28		2 298 09	20 46		18 343 13	66 15		3 28 31	111 48
	19 254 09	336 27		3 299 07	21 46		19 344 12	67 14		4 29 30	112 47
	20 255 08	337 26		4 300 06	22 45		20 345 11	68 14		5 30 29	113 46
	21 256 06	338 25		5 301 05	23 44		21 346 09	69 13		6 31 29	114 46
	22 257 05	339 24		6 302 04	24 43		22 347 08	70 12		7 32 28	115 45
	23 258 04	340 23		7 303 02	25 43		23 348 07	71 12		8 33 27	116 44
	24 259 02	341 22		8 304 01	26 42		24 349 06	72 11		9 34 27	117 44
	25 260 01	342 21		9 305 00	27 41		25 350 05	73 11		10 35 26	118 43
	26 261 00	343 20		10 305 58	28 40		26 351 04	74 10		11 36 25	119 42
	27 261 58	344 19		11 306 57	29 40		27 352 03	75 09		12 37 25	120 42
	28 262 57	345 18		12 307 56	30 39		28 353 02	76 09		13 38 24	121 41
	29 263 56	346 17		13 308 54	31 38		29 354 01	77 08		14 39 23	122 41
	30 264 54	347 16		14 309 53	32 37		30 355 00	78 08		15 40 23	123 40
	31 265 53	348 15		15 310 52	33 37		31 355 59	79 07		16 41 22	124 39
Aug.	1 266 51	349 14		16 311 51	34 36	Nov. 1	356 58	80 07		17 42 21	125 38
	2 267 50	350 13		17 312 49	35 35		2 357 57	81 06		18 43 21	126 38
	3 268 49	351 12		18 313 48	36 34		3 358 56	82 05		19 44 20	127 37
	4 269 47	352 11		19 314 47	37 34		4 359 55	83 05		20 45 20	128 36
	5 270 46	353 10		20 315 46	38 33		5 0 54	84 04		21 46 19	129 36
	6 271 45	354 10		21 316 44	39 32		6 1 53	85 04		22 47 18	130 35
	7 272 43	355 09		22 317 43	40 32		7 2 52	86 03		23 48 18	131 34
	8 273 42	356 08		23 318 42	41 31		8 3 51	87 02		24 49 17	132 34
	9 274 41	357 07		24 319 41	42 30		9 4 51	88 02		25 50 17	133 33
	10 275 39	358 06		25 320 39	43 30		10 5 50	89 01		26 51 16	134 32
	11 276 38	359 05		26 321 38	44 29		11 6 49	90 01		27 52 16	135 32
	12 277 37	0 04		27 322 37	45 28		12 7 48	91 00		28 53 15	136 31
	13 278 35	1 03		28 323 36	46 28		13 8 47	92 00		29 54 14	137 30
	14 279 34	2 02		29 324 35	47 27		14 9 46	92 59		30 55 14	138 30
	15 280 33	3 02		30 325 33	48 26		15 10 45	93 58		31 56 13	139 29
	16 281 31	4 01	Oct. 1	326 32	49 26		16 11 44	94 58		32 57 13	140 28

Form the quantities $C = p \cos(\text{local hour angle})$ and $S = p \sin(\text{local hour angle})$ then
 Latitude $= h_0 - C + 0.0087 S^2 \tan h_0$,

Azimuth of *Polaris* $= -S/\cos h_0$ and Azimuth of σ Octantis $= 180^\circ + S/\cos h_0$, where p and h_0
 are in degrees and h_0 is the observed altitude corrected for atmospheric refraction and instrument error.



The times of sunrise and sunset (pages 24–31) and of moonrise and moonset (pages 32–63) are the instants when the upper limbs of the Sun and Moon appear to lie on the horizon for an observer at sea-level. In both cases a fixed allowance of 34' has been made for refraction; a further allowance of 16' has been made for the semidiameter of the Sun, while for the Moon the actual value of semidiameter *minus* horizontal parallax has been used. No allowance has been made for the phase of the Moon. The observed times may differ from the tabular times because of variations in refraction and the relative heights of the observer and horizon.

The tabular values are for the universal time (UT) of the phenomena on the Greenwich meridian (longitude 0°). To a first approximation the UT at another longitude is given by subtracting the longitude, expressed in time-measure, if east of Greenwich, or by adding, if west of Greenwich. Alternatively the tables may be regarded as giving the approximate local mean time on all meridians. These times may be converted to standard time by applying the appropriate differences, as indicated in the note on page 4. Linear interpolation may be used to obtain the times for non-tabular latitudes.

In the case of the Sun it may be necessary to interpolate (mentally) to obtain the UT for an intermediate date, but a further interpolation for longitude is not normally required. In the case of the Moon the values must normally be interpolated for longitude, as well as for latitude, since the changes in the tabular values from one day to the next are usually large. The interpolating factor is equal to one twenty-fourth of the longitude if expressed in hours and decimals of an hour; linear interpolation is usually adequate.

Example

To find the times of sunrise and sunset and of moonrise and moonset on 2016 February 23 at latitude N 38° 55', longitude W 77° 15'. The longitude expressed in time-measure is W 05^h 09^m. The difference between standard time and UT is −5^h in this case.

The relevant tabular values in UT for longitude 0° are as follows:

		Sunrise		Sunset				Moonrise		Moonset	
		+35°	+40°	+35°	+40°			+35°	+40°	+35°	+40°
d	h m	h m	h m	h m	h m	d	h m	h m	h m	h m	h m
Feb. 20	06 41	06 47	17 47	17 41		Feb. 23	18 41	18 38	06 53	06 57	
24	06 36	06 42	17 51	17 45		24	19 36	19 35	07 26	07 27	

Interpolating factor for latitude is 3° 55'/ 5° = 0.78
 for date for Sun is 3^d/4^d = 0.75
 for long. for Moon is 5^h 15/24^h = 0.21

		Sunrise		Sunset				Moonrise		Moonset	
		d	h m	h m	h m			d	h m	h m	h m
Interpolation to:											
Latitude N 38° 55'	Feb. 20	06 46	17 42	Feb. 23	18 39	06 56					
N 38° 55'	24	06 41	17 46	24	19 35	07 27					
Local mean time	23	06 42	17 45	23	18 51	07 03					
Adjustment to:											
Universal time	23	11 51	22 54	23	00 00	12 12					
Standard time	23	06 51	17 54	23	19 00	07 12					

SUNRISE AND SUNSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
SUNRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. -1	3 23	3 53	4 15	4 33	4 48	5 01	5 22	5 41	5 59	6 16	6 34	6 55	7 07	7 21
3	3 28	3 57	4 19	4 36	4 51	5 03	5 25	5 43	6 01	6 18	6 36	6 56	7 08	7 22
7	3 33	4 01	4 23	4 40	4 54	5 06	5 27	5 46	6 02	6 19	6 37	6 57	7 09	7 22
11	3 40	4 07	4 27	4 44	4 58	5 10	5 30	5 48	6 04	6 20	6 37	6 57	7 08	7 21
15	3 47	4 12	4 32	4 48	5 01	5 13	5 33	5 50	6 06	6 21	6 38	6 57	7 08	7 20
19	3 54	4 19	4 37	4 53	5 05	5 17	5 35	5 52	6 07	6 22	6 38	6 56	7 06	7 18
23	4 02	4 25	4 43	4 57	5 09	5 20	5 38	5 54	6 08	6 22	6 38	6 55	7 05	7 16
27	4 11	4 32	4 49	5 02	5 14	5 24	5 41	5 55	6 09	6 23	6 37	6 53	7 03	7 13
31	4 19	4 39	4 54	5 07	5 18	5 27	5 43	5 57	6 10	6 23	6 36	6 51	7 00	7 10
Feb. 4	4 28	4 46	5 00	5 12	5 22	5 31	5 46	5 58	6 10	6 22	6 35	6 49	6 57	7 06
8	4 36	4 53	5 06	5 17	5 26	5 34	5 48	6 00	6 11	6 22	6 33	6 46	6 54	7 02
12	4 45	5 00	5 12	5 22	5 30	5 37	5 50	6 01	6 11	6 21	6 31	6 43	6 50	6 57
16	4 54	5 07	5 18	5 27	5 34	5 41	5 52	6 02	6 11	6 20	6 29	6 40	6 46	6 52
20	5 02	5 14	5 24	5 31	5 38	5 44	5 54	6 02	6 10	6 18	6 27	6 36	6 41	6 47
24	5 11	5 21	5 29	5 36	5 42	5 47	5 55	6 03	6 10	6 17	6 24	6 32	6 36	6 42
28	5 19	5 28	5 35	5 41	5 45	5 50	5 57	6 03	6 09	6 15	6 21	6 28	6 32	6 36
Mar. 3	5 28	5 35	5 40	5 45	5 49	5 53	5 59	6 04	6 09	6 13	6 18	6 23	6 26	6 30
7	5 36	5 41	5 46	5 49	5 53	5 55	6 00	6 04	6 08	6 11	6 15	6 19	6 21	6 24
11	5 44	5 48	5 51	5 54	5 56	5 58	6 01	6 04	6 07	6 09	6 12	6 14	6 16	6 17
15	5 52	5 54	5 56	5 58	5 59	6 01	6 02	6 04	6 06	6 07	6 08	6 10	6 10	6 11
19	6 00	6 01	6 02	6 02	6 03	6 03	6 04	6 04	6 04	6 05	6 05	6 05	6 05	6 05
23	6 08	6 07	6 07	6 06	6 06	6 05	6 05	6 04	6 03	6 02	6 01	6 00	5 59	5 58
27	6 15	6 13	6 12	6 10	6 09	6 08	6 06	6 04	6 02	6 00	5 58	5 55	5 53	5 52
31	6 23	6 20	6 17	6 14	6 12	6 10	6 07	6 04	6 01	5 58	5 54	5 50	5 48	5 45
Apr. 4	6 31	6 26	6 22	6 18	6 15	6 13	6 08	6 04	6 00	5 55	5 51	5 45	5 42	5 39

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. -1	20 41	20 12	19 49	19 32	19 17	19 04	18 42	18 23	18 06	17 49	17 31	17 10	16 57	16 43
3	20 40	20 11	19 50	19 32	19 18	19 05	18 44	18 25	18 08	17 51	17 33	17 12	17 00	16 47
7	20 38	20 10	19 49	19 32	19 18	19 05	18 45	18 26	18 10	17 53	17 36	17 15	17 04	16 50
11	20 35	20 08	19 48	19 31	19 17	19 06	18 45	18 28	18 11	17 55	17 38	17 19	17 07	16 54
15	20 31	20 05	19 46	19 30	19 17	19 05	18 46	18 29	18 13	17 57	17 41	17 22	17 11	16 59
19	20 26	20 02	19 43	19 28	19 15	19 04	18 45	18 29	18 14	17 59	17 43	17 25	17 15	17 03
23	20 20	19 57	19 40	19 26	19 13	19 03	18 45	18 30	18 15	18 01	17 46	17 29	17 19	17 08
27	20 13	19 52	19 36	19 22	19 11	19 01	18 44	18 30	18 16	18 03	17 49	17 32	17 23	17 12
31	20 06	19 47	19 32	19 19	19 08	18 59	18 43	18 30	18 17	18 04	17 51	17 36	17 27	17 17
Feb. 4	19 59	19 41	19 27	19 15	19 05	18 57	18 42	18 29	18 17	18 06	17 53	17 39	17 31	17 22
8	19 51	19 34	19 21	19 11	19 02	18 54	18 40	18 28	18 18	18 07	17 55	17 43	17 35	17 27
12	19 42	19 27	19 16	19 06	18 58	18 51	18 38	18 28	18 18	18 08	17 58	17 46	17 39	17 32
16	19 33	19 20	19 10	19 01	18 54	18 47	18 36	18 26	18 17	18 09	17 59	17 49	17 43	17 36
20	19 24	19 12	19 03	18 55	18 49	18 43	18 33	18 25	18 17	18 09	18 01	17 52	17 47	17 41
24	19 14	19 04	18 56	18 50	18 44	18 39	18 31	18 23	18 17	18 10	18 03	17 55	17 51	17 45
28	19 05	18 56	18 50	18 44	18 39	18 35	18 28	18 22	18 16	18 10	18 04	17 58	17 54	17 50
Mar. 3	18 55	18 48	18 42	18 38	18 34	18 31	18 25	18 20	18 15	18 11	18 06	18 01	17 58	17 54
7	18 45	18 39	18 35	18 32	18 29	18 26	18 22	18 18	18 14	18 11	18 07	18 03	18 01	17 59
11	18 35	18 31	18 28	18 25	18 23	18 21	18 18	18 16	18 13	18 11	18 09	18 06	18 05	18 03
15	18 25	18 22	18 20	18 19	18 18	18 17	18 15	18 13	18 12	18 11	18 10	18 09	18 08	18 07
19	18 14	18 14	18 13	18 12	18 12	18 12	18 11	18 11	18 11	18 11	18 11	18 11	18 11	18 11
23	18 04	18 05	18 05	18 06	18 06	18 07	18 08	18 09	18 10	18 11	18 12	18 13	18 14	18 15
27	17 54	17 56	17 58	18 00	18 01	18 02	18 04	18 06	18 08	18 11	18 13	18 16	18 18	18 20
31	17 44	17 48	17 51	17 53	17 55	17 57	18 01	18 04	18 07	18 11	18 14	18 18	18 21	18 24
Apr. 4	17 34	17 39	17 43	17 47	17 50	17 53	17 57	18 02	18 06	18 10	18 15	18 21	18 24	18 28

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. -1	7 21	7 28	7 34	7 42	7 50	7 58	8 08	8 19	8 32	8 46	9 03	9 24	9 51	10 31
3	7 22	7 28	7 35	7 42	7 50	7 58	8 08	8 19	8 31	8 45	9 01	9 22	9 48	10 25
7	7 22	7 28	7 34	7 41	7 49	7 57	8 07	8 17	8 29	8 42	8 58	9 18	9 42	10 16
11	7 21	7 27	7 33	7 40	7 48	7 56	8 05	8 15	8 26	8 39	8 54	9 12	9 35	10 06
15	7 20	7 26	7 32	7 38	7 45	7 53	8 02	8 11	8 22	8 34	8 48	9 06	9 27	9 54
19	7 18	7 24	7 30	7 36	7 42	7 50	7 58	8 07	8 17	8 29	8 42	8 58	9 17	9 42
23	7 16	7 21	7 27	7 32	7 39	7 46	7 53	8 02	8 11	8 22	8 35	8 49	9 07	9 29
27	7 13	7 18	7 23	7 29	7 35	7 41	7 48	7 56	8 05	8 15	8 26	8 40	8 56	9 16
31	7 10	7 14	7 19	7 24	7 30	7 36	7 42	7 50	7 58	8 07	8 17	8 30	8 44	9 02
Feb. 4	7 06	7 10	7 15	7 19	7 24	7 30	7 36	7 43	7 50	7 59	8 08	8 19	8 32	8 48
8	7 02	7 06	7 10	7 14	7 19	7 24	7 29	7 35	7 42	7 50	7 58	8 08	8 19	8 33
12	6 57	7 01	7 04	7 08	7 12	7 17	7 22	7 27	7 33	7 40	7 48	7 56	8 07	8 19
16	6 52	6 55	6 59	7 02	7 06	7 10	7 14	7 19	7 24	7 30	7 37	7 45	7 53	8 04
20	6 47	6 50	6 53	6 56	6 59	7 02	7 06	7 10	7 15	7 20	7 26	7 33	7 40	7 49
24	6 42	6 44	6 46	6 49	6 52	6 55	6 58	7 01	7 05	7 10	7 15	7 20	7 27	7 34
28	6 36	6 38	6 40	6 42	6 44	6 47	6 49	6 52	6 56	6 59	7 03	7 08	7 13	7 19
Mar. 3	6 30	6 31	6 33	6 35	6 36	6 38	6 41	6 43	6 45	6 48	6 51	6 55	6 59	7 04
7	6 24	6 25	6 26	6 27	6 29	6 30	6 32	6 33	6 35	6 37	6 40	6 42	6 45	6 49
11	6 17	6 18	6 19	6 20	6 21	6 22	6 23	6 24	6 25	6 26	6 28	6 29	6 31	6 33
15	6 11	6 11	6 12	6 12	6 13	6 13	6 13	6 14	6 14	6 15	6 16	6 16	6 17	6 18
19	6 05	6 05	6 05	6 04	6 04	6 04	6 04	6 04	6 04	6 04	6 04	6 03	6 03	6 03
23	5 58	5 58	5 57	5 57	5 56	5 56	5 55	5 54	5 53	5 52	5 51	5 50	5 49	5 47
27	5 52	5 51	5 50	5 49	5 48	5 47	5 46	5 44	5 43	5 41	5 39	5 37	5 35	5 32
31	5 45	5 44	5 43	5 41	5 40	5 38	5 36	5 34	5 32	5 30	5 27	5 24	5 21	5 17
Apr. 4	5 39	5 37	5 35	5 34	5 32	5 30	5 27	5 25	5 22	5 19	5 15	5 11	5 07	5 01

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. -1	16 43	16 37	16 30	16 23	16 15	16 06	15 57	15 46	15 33	15 19	15 02	14 41	14 13	13 34
3	16 47	16 40	16 34	16 27	16 19	16 10	16 01	15 50	15 38	15 24	15 07	14 47	14 21	13 44
7	16 50	16 44	16 38	16 31	16 23	16 15	16 06	15 55	15 44	15 30	15 14	14 55	14 30	13 56
11	16 54	16 48	16 42	16 36	16 28	16 20	16 11	16 01	15 50	15 37	15 22	15 04	14 41	14 10
15	16 59	16 53	16 47	16 41	16 33	16 26	16 17	16 08	15 57	15 45	15 31	15 13	14 52	14 25
19	17 03	16 58	16 52	16 46	16 39	16 32	16 24	16 15	16 05	15 53	15 40	15 24	15 05	14 40
23	17 08	17 03	16 57	16 51	16 45	16 38	16 31	16 22	16 13	16 02	15 50	15 35	15 17	14 55
27	17 12	17 08	17 03	16 57	16 51	16 45	16 38	16 30	16 21	16 11	16 00	15 46	15 30	15 11
31	17 17	17 13	17 08	17 03	16 57	16 51	16 45	16 38	16 30	16 20	16 10	15 58	15 43	15 26
Feb. 4	17 22	17 18	17 14	17 09	17 04	16 58	16 52	16 46	16 38	16 30	16 21	16 10	15 57	15 41
8	17 27	17 23	17 19	17 15	17 10	17 05	17 00	16 54	16 47	16 40	16 31	16 21	16 10	15 56
12	17 32	17 28	17 25	17 21	17 17	17 12	17 07	17 02	16 56	16 49	16 42	16 33	16 23	16 11
16	17 36	17 33	17 30	17 27	17 23	17 19	17 15	17 10	17 05	16 59	16 52	16 45	16 36	16 26
20	17 41	17 38	17 36	17 33	17 29	17 26	17 22	17 18	17 13	17 08	17 03	16 56	16 49	16 40
24	17 45	17 43	17 41	17 38	17 36	17 33	17 29	17 26	17 22	17 18	17 13	17 08	17 01	16 54
28	17 50	17 48	17 46	17 44	17 42	17 39	17 37	17 34	17 31	17 27	17 23	17 19	17 14	17 08
Mar. 3	17 54	17 53	17 51	17 50	17 48	17 46	17 44	17 42	17 39	17 36	17 33	17 30	17 26	17 21
7	17 59	17 58	17 57	17 55	17 54	17 53	17 51	17 49	17 48	17 46	17 43	17 41	17 38	17 35
11	18 03	18 02	18 02	18 01	18 00	17 59	17 58	17 57	17 56	17 55	17 53	17 52	17 50	17 48
15	18 07	18 07	18 07	18 06	18 06	18 06	18 05	18 05	18 04	18 04	18 03	18 03	18 02	18 01
19	18 11	18 11	18 12	18 12	18 12	18 12	18 12	18 12	18 13	18 13	18 13	18 13	18 14	18 14
23	18 15	18 16	18 16	18 17	18 18	18 18	18 19	18 20	18 21	18 22	18 23	18 24	18 26	18 27
27	18 20	18 20	18 21	18 22	18 23	18 25	18 26	18 27	18 29	18 31	18 33	18 35	18 37	18 40
31	18 24	18 25	18 26	18 28	18 29	18 31	18 33	18 35	18 37	18 40	18 42	18 46	18 49	18 53
Apr. 4	18 28	18 29	18 31	18 33	18 35	18 37	18 40	18 42	18 45	18 48	18 52	18 56	19 01	19 07

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
SUNRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	6 23	6 20	6 17	6 14	6 12	6 10	6 07	6 04	6 01	5 58	5 54	5 50	5 48	5 45
Apr. 4	6 31	6 26	6 22	6 18	6 15	6 13	6 08	6 04	6 00	5 55	5 51	5 45	5 42	5 39
8	6 39	6 32	6 27	6 22	6 18	6 15	6 09	6 04	5 58	5 53	5 47	5 41	5 37	5 32
12	6 46	6 38	6 32	6 26	6 22	6 17	6 10	6 04	5 57	5 51	5 44	5 36	5 32	5 26
16	6 54	6 44	6 37	6 30	6 25	6 20	6 11	6 04	5 56	5 49	5 41	5 32	5 26	5 20
20	7 01	6 51	6 42	6 34	6 28	6 22	6 12	6 04	5 55	5 47	5 38	5 28	5 21	5 14
24	7 09	6 57	6 47	6 38	6 31	6 25	6 14	6 04	5 55	5 45	5 35	5 23	5 17	5 09
28	7 17	7 03	6 52	6 42	6 34	6 27	6 15	6 04	5 54	5 44	5 32	5 20	5 12	5 04
May 2	7 24	7 09	6 56	6 46	6 38	6 30	6 16	6 05	5 53	5 42	5 30	5 16	5 08	4 58
6	7 31	7 15	7 01	6 50	6 41	6 32	6 18	6 05	5 53	5 41	5 28	5 13	5 04	4 54
10	7 38	7 20	7 06	6 54	6 44	6 35	6 19	6 06	5 53	5 40	5 26	5 10	5 00	4 49
14	7 45	7 26	7 10	6 58	6 47	6 37	6 21	6 06	5 53	5 39	5 24	5 07	4 57	4 45
18	7 52	7 31	7 15	7 01	6 50	6 40	6 23	6 07	5 53	5 38	5 23	5 05	4 54	4 42
22	7 58	7 36	7 19	7 05	6 53	6 42	6 24	6 08	5 53	5 38	5 22	5 03	4 52	4 39
26	8 04	7 41	7 23	7 08	6 56	6 45	6 26	6 09	5 53	5 38	5 21	5 01	4 49	4 36
30	8 10	7 45	7 27	7 11	6 58	6 47	6 27	6 10	5 54	5 38	5 20	5 00	4 48	4 34
June 3	8 15	7 49	7 30	7 14	7 01	6 49	6 29	6 11	5 55	5 38	5 20	4 59	4 47	4 32
7	8 19	7 53	7 33	7 16	7 03	6 51	6 30	6 12	5 55	5 38	5 20	4 58	4 46	4 31
11	8 22	7 56	7 35	7 19	7 05	6 52	6 32	6 13	5 56	5 39	5 20	4 58	4 45	4 31
15	8 25	7 58	7 37	7 20	7 06	6 54	6 33	6 14	5 57	5 39	5 20	4 59	4 46	4 31
19	8 26	7 59	7 38	7 22	7 07	6 55	6 34	6 15	5 58	5 40	5 21	4 59	4 46	4 31
23	8 27	8 00	7 39	7 22	7 08	6 56	6 35	6 16	5 59	5 41	5 22	5 00	4 47	4 32
27	8 27	8 00	7 39	7 23	7 09	6 56	6 35	6 17	5 59	5 42	5 23	5 01	4 48	4 33
July 1	8 26	7 59	7 39	7 23	7 09	6 57	6 36	6 17	6 00	5 43	5 24	5 03	4 50	4 35
5	8 24	7 58	7 38	7 22	7 08	6 56	6 36	6 18	6 01	5 44	5 26	5 04	4 52	4 37

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	17 44	17 48	17 51	17 53	17 55	17 57	18 01	18 04	18 07	18 11	18 14	18 18	18 21	18 24
Apr. 4	17 34	17 39	17 43	17 47	17 50	17 53	17 57	18 02	18 06	18 10	18 15	18 21	18 24	18 28
8	17 24	17 31	17 36	17 41	17 44	17 48	17 54	18 00	18 05	18 10	18 16	18 23	18 27	18 32
12	17 14	17 22	17 29	17 34	17 39	17 43	17 51	17 58	18 04	18 10	18 17	18 26	18 30	18 36
16	17 05	17 14	17 22	17 28	17 34	17 39	17 48	17 56	18 03	18 11	18 19	18 28	18 34	18 40
20	16 55	17 06	17 15	17 23	17 29	17 35	17 45	17 54	18 02	18 11	18 20	18 31	18 37	18 44
24	16 46	16 59	17 09	17 17	17 25	17 31	17 42	17 52	18 01	18 11	18 21	18 33	18 40	18 48
28	16 38	16 52	17 03	17 12	17 20	17 27	17 40	17 50	18 01	18 11	18 23	18 36	18 43	18 52
May 2	16 29	16 45	16 57	17 07	17 16	17 24	17 37	17 49	18 00	18 12	18 24	18 38	18 47	18 56
6	16 21	16 38	16 51	17 03	17 12	17 20	17 35	17 48	18 00	18 12	18 26	18 41	18 50	19 00
10	16 14	16 32	16 46	16 58	17 09	17 18	17 33	17 47	18 00	18 13	18 27	18 43	18 53	19 04
14	16 07	16 26	16 42	16 55	17 05	17 15	17 32	17 46	18 00	18 14	18 29	18 46	18 56	19 08
18	16 00	16 21	16 38	16 51	17 03	17 13	17 30	17 46	18 00	18 15	18 30	18 49	18 59	19 12
22	15 54	16 17	16 34	16 48	17 00	17 11	17 29	17 45	18 00	18 16	18 32	18 51	19 02	19 15
26	15 49	16 13	16 31	16 46	16 58	17 09	17 28	17 45	18 01	18 17	18 34	18 53	19 05	19 18
30	15 45	16 09	16 28	16 44	16 57	17 08	17 28	17 45	18 01	18 18	18 35	18 56	19 08	19 22
June 3	15 42	16 07	16 26	16 42	16 56	17 07	17 28	17 45	18 02	18 19	18 37	18 58	19 10	19 24
7	15 39	16 05	16 25	16 41	16 55	17 07	17 28	17 46	18 03	18 20	18 38	19 00	19 12	19 27
11	15 37	16 04	16 24	16 41	16 55	17 07	17 28	17 46	18 03	18 21	18 40	19 01	19 14	19 29
15	15 36	16 03	16 24	16 41	16 55	17 07	17 28	17 47	18 04	18 22	18 41	19 03	19 16	19 31
19	15 36	16 04	16 24	16 41	16 55	17 08	17 29	17 48	18 05	18 23	18 42	19 04	19 17	19 32
23	15 38	16 05	16 25	16 42	16 56	17 09	17 30	17 49	18 06	18 24	18 43	19 05	19 18	19 33
27	15 39	16 06	16 27	16 44	16 58	17 10	17 31	17 49	18 07	18 24	18 43	19 05	19 18	19 33
July 1	15 42	16 09	16 29	16 45	16 59	17 11	17 32	17 50	18 08	18 25	18 44	19 05	19 18	19 33
5	15 46	16 12	16 31	16 48	17 01	17 13	17 34	17 51	18 08	18 25	18 44	19 05	19 17	19 32

SUNRISE AND SUNSET, 2016

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

27

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	5 45	5 44	5 43	5 41	5 40	5 38	5 36	5 34	5 32	5 30	5 27	5 24	5 21	5 17
Apr. 4	5 39	5 37	5 35	5 34	5 32	5 30	5 27	5 25	5 22	5 19	5 15	5 11	5 07	5 01
8	5 32	5 30	5 28	5 26	5 24	5 21	5 18	5 15	5 11	5 08	5 03	4 58	4 52	4 46
12	5 26	5 24	5 21	5 19	5 16	5 13	5 09	5 05	5 01	4 57	4 51	4 45	4 38	4 30
16	5 20	5 18	5 15	5 12	5 08	5 04	5 00	4 56	4 51	4 46	4 39	4 32	4 24	4 15
20	5 14	5 11	5 08	5 04	5 01	4 56	4 52	4 47	4 41	4 35	4 28	4 20	4 10	3 59
24	5 09	5 05	5 02	4 58	4 53	4 49	4 44	4 38	4 32	4 24	4 16	4 07	3 56	3 43
28	5 04	5 00	4 56	4 51	4 46	4 41	4 35	4 29	4 22	4 14	4 05	3 55	3 42	3 28
May 2	4 58	4 54	4 50	4 45	4 40	4 34	4 28	4 21	4 13	4 04	3 54	3 43	3 29	3 12
6	4 54	4 49	4 44	4 39	4 33	4 27	4 20	4 13	4 04	3 55	3 44	3 31	3 15	2 56
10	4 49	4 45	4 39	4 34	4 28	4 21	4 14	4 05	3 56	3 46	3 34	3 19	3 02	2 40
14	4 45	4 40	4 35	4 29	4 22	4 15	4 07	3 58	3 48	3 37	3 24	3 08	2 49	2 25
18	4 42	4 36	4 31	4 24	4 17	4 10	4 01	3 52	3 41	3 29	3 15	2 58	2 36	2 09
22	4 39	4 33	4 27	4 20	4 13	4 05	3 56	3 46	3 35	3 22	3 06	2 48	2 24	1 52
26	4 36	4 30	4 24	4 17	4 09	4 01	3 51	3 41	3 29	3 15	2 59	2 39	2 13	1 36
30	4 34	4 28	4 21	4 14	4 06	3 57	3 47	3 36	3 24	3 09	2 52	2 30	2 02	1 19
June 3	4 32	4 26	4 19	4 12	4 03	3 54	3 44	3 33	3 20	3 04	2 46	2 23	1 52	1 02
7	4 31	4 25	4 18	4 10	4 01	3 52	3 42	3 30	3 16	3 01	2 41	2 17	1 44	0 43
11	4 31	4 24	4 17	4 09	4 00	3 51	3 40	3 28	3 14	2 58	2 31	2 13	1 37	0 18
15	4 31	4 24	4 17	4 09	4 00	3 50	3 39	3 27	3 13	2 56	2 36	2 10	1 33	□
19	4 31	4 24	4 17	4 09	4 00	3 50	3 39	3 27	3 13	2 56	2 36	2 09	1 31	□
23	4 32	4 25	4 18	4 10	4 01	3 51	3 40	3 28	3 14	2 57	2 36	2 10	1 32	□
27	4 33	4 26	4 19	4 11	4 03	3 53	3 42	3 30	3 16	2 59	2 39	2 13	1 36	□
July 1	4 35	4 28	4 21	4 13	4 05	3 55	3 45	3 33	3 19	3 02	2 43	2 17	1 42	0 24
5	4 37	4 31	4 24	4 16	4 07	3 58	3 48	3 36	3 23	3 07	2 48	2 23	1 50	0 49

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	18 24	18 25	18 26	18 28	18 29	18 31	18 33	18 35	18 37	18 40	18 42	18 46	18 49	18 53
Apr. 4	18 28	18 29	18 31	18 33	18 35	18 37	18 40	18 42	18 45	18 48	18 52	18 56	19 01	19 07
8	18 32	18 34	18 36	18 38	18 41	18 43	18 46	18 50	18 53	18 57	19 02	19 07	19 13	19 20
12	18 36	18 38	18 41	18 43	18 46	18 50	18 53	18 57	19 01	19 06	19 12	19 18	19 25	19 33
16	18 40	18 43	18 46	18 49	18 52	18 56	19 00	19 05	19 10	19 15	19 22	19 29	19 37	19 47
20	18 44	18 47	18 50	18 54	18 58	19 02	19 07	19 12	19 18	19 24	19 32	19 40	19 50	20 01
24	18 48	18 51	18 55	18 59	19 04	19 08	19 14	19 19	19 26	19 33	19 41	19 51	20 02	20 15
28	18 52	18 56	19 00	19 05	19 09	19 15	19 20	19 27	19 34	19 42	19 51	20 02	20 15	20 30
May 2	18 56	19 00	19 05	19 10	19 15	19 21	19 27	19 34	19 42	19 51	20 01	20 13	20 27	20 45
6	19 00	19 05	19 10	19 15	19 21	19 27	19 34	19 41	19 50	20 00	20 11	20 24	20 40	21 00
10	19 04	19 09	19 14	19 20	19 26	19 33	19 40	19 49	19 58	20 09	20 21	20 36	20 53	21 15
14	19 08	19 13	19 19	19 25	19 31	19 39	19 47	19 55	20 06	20 17	20 31	20 46	21 06	21 31
18	19 12	19 17	19 23	19 29	19 36	19 44	19 53	20 02	20 13	20 25	20 40	20 57	21 19	21 48
22	19 15	19 21	19 27	19 34	19 41	19 49	19 58	20 08	20 20	20 33	20 49	21 08	21 32	22 05
26	19 18	19 24	19 31	19 38	19 46	19 54	20 04	20 14	20 26	20 40	20 57	21 17	21 44	22 22
30	19 22	19 28	19 35	19 42	19 50	19 59	20 09	20 20	20 32	20 47	21 05	21 27	21 55	22 40
June 3	19 24	19 31	19 38	19 45	19 54	20 03	20 13	20 24	20 38	20 53	21 12	21 35	22 06	22 59
7	19 27	19 33	19 41	19 48	19 57	20 06	20 17	20 28	20 42	20 58	21 17	21 42	22 16	23 20
11	19 29	19 36	19 43	19 51	19 59	20 09	20 20	20 32	20 46	21 02	21 22	21 48	22 24	23 54
15	19 31	19 37	19 45	19 53	20 01	20 11	20 22	20 34	20 48	21 05	21 25	21 52	22 29	□
19	19 32	19 39	19 46	19 54	20 03	20 13	20 23	20 36	20 50	21 07	21 27	21 54	22 32	□
23	19 33	19 39	19 47	19 55	20 04	20 13	20 24	20 36	20 51	21 07	21 28	21 54	22 32	□
27	19 33	19 40	19 47	19 55	20 04	20 13	20 24	20 36	20 50	21 07	21 27	21 53	22 30	□
July 1	19 33	19 39	19 46	19 54	20 03	20 12	20 23	20 35	20 49	21 05	21 25	21 50	22 25	23 37
5	19 32	19 38	19 45	19 53	20 01	20 11	20 21	20 33	20 46	21 02	21 21	21 45	22 17	23 15

□ indicates Sun continuously above horizon.

SUNRISE AND SUNSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
SUNRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	8 26	7 59	7 39	7 23	7 09	6 57	6 36	6 17	6 00	5 43	5 24	5 03	4 50	4 35
5	8 24	7 58	7 38	7 22	7 08	6 56	6 36	6 18	6 01	5 44	5 26	5 04	4 52	4 37
9	8 21	7 56	7 36	7 21	7 07	6 56	6 36	6 18	6 02	5 45	5 27	5 06	4 54	4 40
13	8 17	7 53	7 34	7 19	7 06	6 55	6 35	6 18	6 02	5 46	5 29	5 08	4 56	4 43
17	8 13	7 49	7 32	7 17	7 04	6 53	6 35	6 18	6 03	5 47	5 30	5 10	4 59	4 46
21	8 07	7 45	7 28	7 14	7 02	6 52	6 34	6 18	6 03	5 48	5 32	5 13	5 02	4 49
25	8 01	7 41	7 24	7 11	7 00	6 50	6 32	6 17	6 03	5 49	5 33	5 15	5 04	4 52
29	7 55	7 35	7 20	7 07	6 57	6 47	6 31	6 17	6 03	5 49	5 34	5 17	5 07	4 56
Aug. 2	7 47	7 29	7 15	7 03	6 53	6 44	6 29	6 16	6 03	5 50	5 36	5 20	5 10	5 00
6	7 40	7 23	7 10	6 59	6 50	6 41	6 27	6 14	6 02	5 50	5 37	5 22	5 13	5 03
10	7 31	7 16	7 04	6 54	6 46	6 38	6 25	6 13	6 02	5 51	5 39	5 25	5 16	5 07
14	7 23	7 09	6 58	6 49	6 41	6 34	6 22	6 11	6 01	5 51	5 40	5 27	5 19	5 11
18	7 14	7 02	6 52	6 44	6 37	6 30	6 19	6 10	6 00	5 51	5 41	5 29	5 22	5 15
22	7 05	6 54	6 45	6 38	6 32	6 26	6 16	6 08	5 59	5 51	5 42	5 32	5 25	5 19
26	6 55	6 46	6 38	6 32	6 27	6 22	6 13	6 06	5 58	5 51	5 43	5 34	5 28	5 22
30	6 46	6 38	6 31	6 26	6 21	6 17	6 10	6 03	5 57	5 51	5 44	5 36	5 31	5 26
Sept. 3	6 36	6 29	6 24	6 20	6 16	6 13	6 06	6 01	5 56	5 51	5 45	5 38	5 34	5 30
7	6 26	6 21	6 17	6 13	6 10	6 08	6 03	5 59	5 55	5 50	5 46	5 40	5 37	5 34
11	6 16	6 12	6 09	6 07	6 05	6 03	5 59	5 56	5 53	5 50	5 47	5 43	5 40	5 37
15	6 06	6 04	6 02	6 00	5 59	5 58	5 56	5 54	5 52	5 50	5 47	5 45	5 43	5 41
19	5 55	5 55	5 54	5 54	5 53	5 53	5 52	5 51	5 50	5 49	5 48	5 47	5 46	5 45
23	5 45	5 46	5 47	5 47	5 48	5 48	5 48	5 49	5 49	5 49	5 49	5 49	5 49	5 49
27	5 35	5 37	5 39	5 40	5 42	5 43	5 45	5 46	5 48	5 49	5 50	5 51	5 52	5 53
Oct. 1	5 25	5 28	5 31	5 34	5 36	5 38	5 41	5 44	5 46	5 49	5 51	5 54	5 55	5 57
5	5 14	5 20	5 24	5 27	5 30	5 33	5 38	5 41	5 45	5 48	5 52	5 56	5 58	6 01

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	15 42	16 09	16 29	16 45	16 59	17 11	17 32	17 50	18 08	18 25	18 44	19 05	19 18	19 33
5	15 46	16 12	16 31	16 48	17 01	17 13	17 34	17 51	18 08	18 25	18 44	19 05	19 17	19 32
9	15 50	16 15	16 34	16 50	17 03	17 15	17 35	17 52	18 09	18 26	18 43	19 04	19 16	19 31
13	15 55	16 19	16 38	16 53	17 06	17 17	17 36	17 53	18 09	18 26	18 43	19 03	19 15	19 29
17	16 00	16 23	16 41	16 56	17 08	17 19	17 38	17 54	18 10	18 25	18 42	19 02	19 13	19 26
21	16 06	16 28	16 45	16 59	17 11	17 21	17 39	17 55	18 10	18 25	18 41	19 00	19 11	19 24
25	16 12	16 33	16 49	17 02	17 14	17 24	17 41	17 56	18 10	18 24	18 40	18 58	19 08	19 20
29	16 19	16 38	16 53	17 06	17 17	17 26	17 42	17 56	18 10	18 24	18 38	18 55	19 05	19 16
Aug. 2	16 26	16 44	16 58	17 09	17 19	17 28	17 44	17 57	18 10	18 22	18 36	18 52	19 02	19 12
6	16 33	16 49	17 02	17 13	17 22	17 31	17 45	17 57	18 09	18 21	18 34	18 49	18 58	19 08
10	16 40	16 55	17 07	17 17	17 25	17 33	17 46	17 58	18 09	18 20	18 32	18 46	18 54	19 03
14	16 47	17 01	17 11	17 21	17 28	17 35	17 47	17 58	18 08	18 18	18 29	18 42	18 49	18 58
18	16 54	17 06	17 16	17 24	17 31	17 38	17 48	17 58	18 07	18 16	18 26	18 38	18 44	18 52
22	17 02	17 12	17 21	17 28	17 34	17 40	17 49	17 58	18 06	18 14	18 23	18 33	18 39	18 46
26	17 09	17 18	17 25	17 32	17 37	17 42	17 50	17 58	18 05	18 12	18 20	18 29	18 34	18 40
30	17 16	17 24	17 30	17 35	17 40	17 44	17 51	17 58	18 04	18 10	18 17	18 24	18 29	18 34
Sept. 3	17 23	17 30	17 35	17 39	17 43	17 46	17 52	17 57	18 02	18 08	18 13	18 20	18 23	18 28
7	17 31	17 36	17 40	17 43	17 46	17 48	17 53	17 57	18 01	18 05	18 10	18 15	18 18	18 21
11	17 38	17 42	17 44	17 47	17 49	17 51	17 54	17 57	18 00	18 03	18 06	18 10	18 12	18 15
15	17 46	17 47	17 49	17 50	17 52	17 53	17 55	17 56	17 58	18 00	18 02	18 05	18 06	18 08
19	17 53	17 53	17 54	17 54	17 54	17 55	17 55	17 56	17 57	17 58	17 59	18 00	18 01	18 02
23	18 00	17 59	17 59	17 58	17 57	17 57	17 56	17 56	17 55	17 55	17 55	17 55	17 55	17 55
27	18 08	18 05	18 03	18 02	18 00	17 59	17 57	17 56	17 54	17 53	17 51	17 50	17 49	17 48
Oct. 1	18 16	18 12	18 08	18 06	18 03	18 02	17 58	17 55	17 53	17 50	17 48	17 45	17 44	17 42
5	18 23	18 18	18 13	18 10	18 07	18 04	17 59	17 55	17 52	17 48	17 44	17 40	17 38	17 35

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	4 35	4 28	4 21	4 13	4 05	3 55	3 45	3 33	3 19	3 02	2 43	2 17	1 42	0 24
5	4 37	4 31	4 24	4 16	4 07	3 58	3 48	3 36	3 23	3 07	2 48	2 23	1 50	0 49
9	4 40	4 33	4 26	4 19	4 11	4 02	3 52	3 40	3 27	3 12	2 54	2 31	2 00	1 10
13	4 43	4 36	4 30	4 22	4 14	4 06	3 56	3 45	3 32	3 18	3 01	2 39	2 11	1 28
17	4 46	4 40	4 33	4 26	4 19	4 10	4 01	3 50	3 38	3 25	3 08	2 48	2 22	1 46
21	4 49	4 43	4 37	4 30	4 23	4 15	4 06	3 56	3 45	3 32	3 17	2 58	2 35	2 03
25	4 52	4 47	4 41	4 35	4 28	4 20	4 12	4 02	3 52	3 40	3 25	3 08	2 47	2 19
29	4 56	4 51	4 45	4 39	4 33	4 26	4 18	4 09	3 59	3 48	3 34	3 19	3 00	2 35
Aug. 2	5 00	4 55	4 50	4 44	4 38	4 31	4 24	4 16	4 06	3 56	3 44	3 30	3 12	2 51
6	5 03	4 59	4 54	4 49	4 43	4 37	4 30	4 23	4 14	4 04	3 53	3 40	3 25	3 06
10	5 07	5 03	4 58	4 54	4 48	4 43	4 36	4 30	4 22	4 13	4 03	3 51	3 38	3 21
14	5 11	5 07	5 03	4 59	4 54	4 49	4 43	4 37	4 30	4 22	4 13	4 02	3 50	3 35
18	5 15	5 11	5 08	5 04	4 59	4 55	4 49	4 44	4 37	4 30	4 22	4 13	4 02	3 49
22	5 19	5 15	5 12	5 09	5 05	5 01	4 56	4 51	4 45	4 39	4 32	4 24	4 14	4 03
26	5 22	5 20	5 17	5 14	5 10	5 06	5 02	4 58	4 53	4 48	4 41	4 34	4 26	4 16
30	5 26	5 24	5 21	5 19	5 16	5 12	5 09	5 05	5 01	4 56	4 51	4 45	4 38	4 30
Sept. 3	5 30	5 28	5 26	5 24	5 21	5 18	5 16	5 12	5 09	5 05	5 00	4 55	4 50	4 43
7	5 34	5 32	5 30	5 29	5 27	5 24	5 22	5 19	5 17	5 13	5 10	5 06	5 01	4 56
11	5 37	5 36	5 35	5 33	5 32	5 30	5 29	5 27	5 24	5 22	5 19	5 16	5 13	5 08
15	5 41	5 40	5 39	5 38	5 37	5 36	5 35	5 34	5 32	5 30	5 29	5 26	5 24	5 21
19	5 45	5 44	5 44	5 43	5 43	5 42	5 42	5 41	5 40	5 39	5 38	5 37	5 35	5 34
23	5 49	5 49	5 49	5 49	5 48	5 48	5 48	5 48	5 48	5 48	5 47	5 47	5 47	5 46
27	5 53	5 53	5 53	5 54	5 54	5 54	5 55	5 55	5 56	5 56	5 57	5 57	5 58	5 59
Oct. 1	5 57	5 57	5 58	5 59	6 00	6 00	6 01	6 02	6 04	6 05	6 06	6 08	6 10	6 12
5	6 01	6 02	6 03	6 04	6 05	6 07	6 08	6 10	6 12	6 14	6 16	6 18	6 21	6 25

SUNSET

		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July	1	19 33	19 39	19 46	19 54	20 03	20 12	20 23	20 35	20 49	21 05	21 25	21 50	22 25	23 37	
	5	19 32	19 38	19 45	19 53	20 01	20 11	20 21	20 33	20 46	21 02	21 21	21 45	22 17	23 15	
	9	19 31	19 37	19 44	19 51	19 59	20 08	20 18	20 30	20 43	20 58	21 16	21 38	22 09	22 57	
	13	19 29	19 35	19 42	19 49	19 57	20 05	20 15	20 26	20 38	20 53	21 10	21 31	21 59	22 40	
	17	19 26	19 32	19 39	19 46	19 53	20 01	20 11	20 21	20 33	20 47	21 03	21 22	21 48	22 23	
Aug.	21	19 24	19 29	19 35	19 42	19 49	19 57	20 06	20 16	20 27	20 40	20 55	21 13	21 36	22 07	
	25	19 20	19 26	19 31	19 38	19 44	19 52	20 00	20 10	20 20	20 32	20 46	21 03	21 23	21 50	
	29	19 16	19 22	19 27	19 33	19 39	19 46	19 54	20 03	20 13	20 24	20 37	20 52	21 11	21 34	
	2	19 12	19 17	19 22	19 28	19 34	19 40	19 48	19 56	20 05	20 15	20 27	20 41	20 58	21 19	
	6	19 08	19 12	19 17	19 22	19 28	19 34	19 40	19 48	19 56	20 06	20 17	20 29	20 44	21 03	
	10	19 03	19 07	19 11	19 16	19 21	19 27	19 33	19 40	19 47	19 56	20 06	20 17	20 31	20 47	
	14	18 58	19 01	19 05	19 10	19 14	19 19	19 25	19 31	19 38	19 46	19 55	20 05	20 17	20 31	
	18	18 52	18 55	18 59	19 03	19 07	19 12	19 17	19 22	19 29	19 36	19 43	19 53	20 03	20 16	
Sept.	22	18 46	18 49	18 53	18 56	19 00	19 04	19 08	19 13	19 19	19 25	19 32	19 40	19 49	20 00	
	26	18 40	18 43	18 46	18 49	18 52	18 56	19 00	19 04	19 09	19 14	19 20	19 27	19 35	19 45	
	30	18 34	18 36	18 39	18 42	18 44	18 47	18 51	18 55	18 59	19 03	19 08	19 14	19 21	19 29	
	3	18 28	18 30	18 32	18 34	18 36	18 39	18 42	18 45	18 48	18 52	18 56	19 01	19 07	19 13	
	7	18 21	18 23	18 25	18 26	18 28	18 30	18 33	18 35	18 38	18 41	18 44	18 48	18 53	18 58	
	11	18 15	18 16	18 17	18 19	18 20	18 22	18 23	18 25	18 27	18 30	18 32	18 35	18 39	18 42	
	15	18 08	18 09	18 10	18 11	18 12	18 13	18 14	18 15	18 17	18 18	18 20	18 22	18 24	18 27	
	19	18 02	18 02	18 02	18 03	18 03	18 04	18 05	18 05	18 06	18 07	18 08	18 09	18 10	18 12	
Oct.	23	17 55	17 55	17 55	17 55	17 55	17 55	17 55	17 55	17 55	17 56	17 56	17 56	17 56	17 56	
	27	17 48	17 48	17 48	17 47	17 47	17 46	17 46	17 45	17 45	17 44	17 44	17 43	17 42	17 41	
	1	17 42	17 41	17 40	17 39	17 39	17 38	17 37	17 36	17 34	17 33	17 31	17 30	17 28	17 26	
	5	17 35	17 34	17 33	17 32	17 30	17 29	17 27	17 26	17 24	17 22	17 19	17 17	17 14	17 10	

SUNRISE AND SUNSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
SUNRISE

Lat.		-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct.	1	5 25	5 28	5 31	5 34	5 36	5 38	5 41	5 44	5 46	5 49	5 51	5 54	5 55	5 57
	5	5 14	5 20	5 24	5 27	5 30	5 33	5 38	5 41	5 45	5 48	5 52	5 56	5 58	6 01
	9	5 04	5 11	5 17	5 21	5 25	5 28	5 34	5 39	5 44	5 48	5 53	5 58	6 01	6 05
	13	4 54	5 03	5 09	5 15	5 20	5 24	5 31	5 37	5 43	5 48	5 54	6 01	6 04	6 09
	17	4 45	4 54	5 02	5 09	5 15	5 19	5 28	5 35	5 42	5 49	5 56	6 03	6 08	6 13
	21	4 35	4 46	4 56	5 03	5 10	5 15	5 25	5 33	5 41	5 49	5 57	6 06	6 11	6 17
	25	4 26	4 39	4 49	4 58	5 05	5 11	5 22	5 32	5 41	5 49	5 59	6 09	6 15	6 22
	29	4 17	4 31	4 43	4 52	5 00	5 08	5 20	5 30	5 40	5 50	6 00	6 12	6 18	6 26
	Nov. 2	4 08	4 24	4 37	4 47	4 56	5 04	5 18	5 29	5 40	5 51	6 02	6 15	6 22	6 31
		6	4 00	4 17	4 31	4 43	4 53	5 01	5 16	5 28	5 40	5 52	6 04	6 18	6 35
	10	3 52	4 11	4 26	4 39	4 49	4 59	5 14	5 28	5 40	5 53	6 06	6 21	6 30	6 40
	14	3 45	4 06	4 22	4 35	4 46	4 56	5 13	5 27	5 41	5 54	6 08	6 24	6 34	6 44
	18	3 38	4 00	4 18	4 32	4 44	4 54	5 12	5 27	5 42	5 56	6 11	6 28	6 38	6 49
	22	3 32	3 56	4 14	4 29	4 42	4 53	5 12	5 28	5 43	5 57	6 13	6 31	6 42	6 53
	26	3 27	3 52	4 12	4 27	4 40	4 52	5 11	5 28	5 44	5 59	6 16	6 34	6 45	6 58
	30	3 23	3 49	4 09	4 26	4 39	4 51	5 12	5 29	5 45	6 01	6 18	6 38	6 49	7 02
	Dec. 4	3 19	3 47	4 08	4 25	4 39	4 51	5 12	5 30	5 47	6 03	6 21	6 41	6 52	7 06
		8	3 17	3 45	4 07	4 24	4 39	4 52	5 13	5 31	5 48	6 05	6 23	6 44	6 56
	12	3 16	3 45	4 07	4 25	4 40	4 52	5 14	5 33	5 50	6 07	6 26	6 47	6 59	7 13
	16	3 15	3 45	4 08	4 26	4 41	4 54	5 16	5 35	5 52	6 09	6 28	6 49	7 01	7 16
	20	3 17	3 47	4 09	4 27	4 42	4 55	5 17	5 36	5 54	6 12	6 30	6 51	7 04	7 18
	24	3 19	3 49	4 11	4 29	4 44	4 57	5 19	5 38	5 56	6 13	6 32	6 53	7 06	7 20
	28	3 22	3 52	4 14	4 32	4 47	5 00	5 22	5 41	5 58	6 15	6 34	6 55	7 07	7 21
	32	3 26	3 55	4 17	4 35	4 50	5 03	5 24	5 43	6 00	6 17	6 35	6 56	7 08	7 22
	36	3 32	4 00	4 21	4 39	4 53	5 05	5 27	5 45	6 02	6 19	6 36	6 57	7 09	7 22

SUNSET

		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct.	1	18 16	18 12	18 08	18 06	18 03	18 02	17 58	17 55	17 53	17 50	17 48	17 45	17 44	17 42
	5	18 23	18 18	18 13	18 10	18 07	18 04	17 57	17 55	17 52	17 48	17 44	17 40	17 38	17 35
	9	18 31	18 24	18 19	18 14	18 10	18 06	18 00	17 55	17 50	17 46	17 41	17 36	17 33	17 29
	13	18 39	18 31	18 24	18 18	18 13	18 09	18 02	17 55	17 49	17 44	17 38	17 31	17 27	17 23
	17	18 47	18 37	18 29	18 22	18 17	18 12	18 03	17 55	17 49	17 42	17 35	17 27	17 22	17 17
	21	18 55	18 44	18 34	18 27	18 20	18 14	18 04	17 56	17 48	17 40	17 32	17 23	17 17	17 11
	25	19 04	18 50	18 40	18 31	18 24	18 17	18 06	17 56	17 47	17 39	17 29	17 19	17 13	17 06
	29	19 12	18 57	18 45	18 36	18 27	18 20	18 08	17 57	17 47	17 37	17 27	17 15	17 08	17 01
	Nov. 2	19 21	19 04	18 51	18 40	18 31	18 23	18 10	17 58	17 47	17 36	17 25	17 12	17 04	16 56
		6	19 29	19 11	18 57	18 45	18 35	18 27	18 12	17 59	17 47	17 35	17 23	17 09	16 52
	10	19 37	19 18	19 02	18 50	18 39	18 30	18 14	18 00	17 47	17 35	17 22	17 06	16 58	16 48
	14	19 46	19 24	19 08	18 54	18 43	18 33	18 16	18 02	17 48	17 35	17 20	17 04	16 55	16 44
	18	19 54	19 31	19 13	18 59	18 47	18 37	18 19	18 03	17 49	17 35	17 20	17 02	16 53	16 41
	22	20 02	19 37	19 19	19 04	18 51	18 40	18 21	18 05	17 50	17 35	17 19	17 01	16 51	16 39
	26	20 09	19 44	19 24	19 08	18 55	18 43	18 24	18 07	17 51	17 36	17 19	17 00	16 49	16 37
	30	20 16	19 49	19 29	19 12	18 59	18 47	18 26	18 09	17 52	17 36	17 19	17 00	16 48	16 35
	Dec. 4	20 22	19 54	19 33	19 16	19 02	18 50	18 29	18 11	17 54	17 38	17 20	17 00	16 48	16 35
		8	20 28	19 59	19 37	19 20	19 05	18 53	18 31	18 13	17 56	17 39	17 21	17 00	16 48
	12	20 33	20 03	19 41	19 23	19 08	18 56	18 34	18 15	17 58	17 40	17 22	17 01	16 49	16 35
	16	20 36	20 06	19 44	19 26	19 11	18 58	18 36	18 17	18 00	17 42	17 24	17 03	16 50	16 36
	20	20 39	20 09	19 46	19 28	19 13	19 00	18 38	18 19	18 02	17 44	17 26	17 04	16 52	16 38
	24	20 41	20 11	19 48	19 30	19 15	19 02	18 40	18 21	18 04	17 46	17 28	17 06	16 54	16 40
	28	20 41	20 12	19 49	19 31	19 16	19 04	18 42	18 23	18 06	17 48	17 30	17 09	16 57	16 42
	32	20 41	20 11	19 50	19 32	19 17	19 05	18 43	18 25	18 07	17 50	17 32	17 12	16 59	16 46
	36	20 39	20 11	19 49	19 32	19 18	19 05	18 44	18 26	18 09	17 53	17 35	17 14	17 03	16 49

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	5 57	5 57	5 58	5 59	6 00	6 00	6 01	6 02	6 04	6 05	6 06	6 08	6 10	6 12
5	6 01	6 02	6 03	6 04	6 05	6 07	6 08	6 10	6 12	6 14	6 16	6 18	6 21	6 25
9	6 05	6 06	6 08	6 09	6 11	6 13	6 15	6 17	6 20	6 22	6 26	6 29	6 33	6 38
13	6 09	6 11	6 12	6 15	6 17	6 19	6 22	6 25	6 28	6 31	6 35	6 40	6 45	6 51
17	6 13	6 15	6 17	6 20	6 23	6 26	6 29	6 32	6 36	6 40	6 45	6 51	6 57	7 04
21	6 17	6 20	6 23	6 25	6 29	6 32	6 36	6 40	6 44	6 49	6 55	7 02	7 09	7 18
25	6 22	6 24	6 28	6 31	6 35	6 39	6 43	6 48	6 53	6 59	7 05	7 13	7 21	7 32
29	6 26	6 29	6 33	6 37	6 41	6 45	6 50	6 55	7 01	7 08	7 15	7 24	7 34	7 46
Nov. 2	6 31	6 34	6 38	6 42	6 47	6 52	6 57	7 03	7 10	7 17	7 26	7 35	7 47	8 00
6	6 35	6 39	6 43	6 48	6 53	6 59	7 04	7 11	7 18	7 27	7 36	7 47	8 00	8 15
10	6 40	6 44	6 49	6 54	6 59	7 05	7 12	7 19	7 27	7 36	7 46	7 58	8 12	8 30
14	6 44	6 49	6 54	6 59	7 05	7 12	7 19	7 26	7 35	7 45	7 56	8 10	8 25	8 45
18	6 49	6 54	6 59	7 05	7 11	7 18	7 26	7 34	7 43	7 54	8 06	8 21	8 38	9 00
22	6 53	6 59	7 04	7 10	7 17	7 24	7 32	7 41	7 51	8 03	8 16	8 32	8 51	9 15
26	6 58	7 03	7 09	7 16	7 23	7 30	7 39	7 48	7 59	8 11	8 25	8 42	9 03	9 30
30	7 02	7 08	7 14	7 21	7 28	7 36	7 45	7 55	8 06	8 19	8 34	8 52	9 14	9 45
Dec. 4	7 06	7 12	7 18	7 25	7 33	7 41	7 50	8 00	8 12	8 26	8 41	9 01	9 25	9 58
8	7 09	7 16	7 22	7 29	7 37	7 46	7 55	8 06	8 18	8 32	8 48	9 08	9 34	10 11
12	7 13	7 19	7 26	7 33	7 41	7 50	7 59	8 10	8 23	8 37	8 54	9 15	9 42	10 22
16	7 16	7 22	7 29	7 36	7 44	7 53	8 03	8 14	8 26	8 41	8 58	9 20	9 48	10 30
20	7 18	7 24	7 31	7 39	7 47	7 56	8 05	8 17	8 29	8 44	9 02	9 23	9 52	10 34
24	7 20	7 26	7 33	7 40	7 48	7 57	8 07	8 18	8 31	8 46	9 03	9 25	9 53	10 35
28	7 21	7 27	7 34	7 42	7 50	7 58	8 08	8 19	8 32	8 46	9 03	9 25	9 52	10 33
32	7 22	7 28	7 35	7 42	7 50	7 58	8 08	8 19	8 31	8 45	9 02	9 23	9 49	10 27
36	7 22	7 28	7 35	7 42	7 49	7 58	8 07	8 18	8 30	8 43	8 59	9 19	9 44	10 19

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	17 42	17 41	17 40	17 39	17 39	17 38	17 37	17 36	17 34	17 33	17 31	17 30	17 28	17 26
5	17 35	17 34	17 33	17 32	17 30	17 29	17 27	17 26	17 24	17 22	17 19	17 17	17 14	17 10
9	17 29	17 28	17 26	17 24	17 23	17 21	17 18	17 16	17 14	17 11	17 08	17 04	17 00	16 55
13	17 23	17 21	17 19	17 17	17 15	17 12	17 10	17 07	17 03	17 00	16 56	16 51	16 46	16 40
17	17 17	17 15	17 12	17 10	17 07	17 04	17 01	16 57	16 53	16 49	16 44	16 39	16 32	16 25
21	17 11	17 09	17 06	17 03	17 00	16 56	16 52	16 48	16 44	16 39	16 33	16 26	16 19	16 10
25	17 06	17 03	17 00	16 56	16 53	16 49	16 44	16 40	16 34	16 28	16 22	16 14	16 05	15 55
29	17 01	16 57	16 54	16 50	16 46	16 41	16 37	16 31	16 25	16 19	16 11	16 02	15 52	15 40
Nov. 2	16 56	16 52	16 48	16 44	16 40	16 35	16 29	16 23	16 16	16 09	16 01	15 51	15 39	15 26
6	16 52	16 48	16 43	16 39	16 34	16 28	16 22	16 16	16 08	16 00	15 50	15 40	15 27	15 11
10	16 48	16 43	16 39	16 34	16 28	16 22	16 16	16 08	16 00	15 51	15 41	15 29	15 15	14 57
14	16 44	16 40	16 34	16 29	16 23	16 17	16 10	16 02	15 53	15 43	15 32	15 19	15 03	14 43
18	16 41	16 36	16 31	16 25	16 19	16 12	16 04	15 56	15 47	15 36	15 24	15 09	14 52	14 30
22	16 39	16 33	16 28	16 22	16 15	16 08	16 00	15 51	15 41	15 29	15 16	15 00	14 41	14 17
26	16 37	16 31	16 25	16 19	16 12	16 04	15 56	15 46	15 36	15 23	15 09	14 52	14 31	14 04
30	16 35	16 30	16 23	16 17	16 09	16 01	15 53	15 43	15 31	15 19	15 04	14 45	14 23	13 52
Dec. 4	16 35	16 29	16 22	16 15	16 08	15 59	15 50	15 40	15 28	15 15	14 59	14 40	14 15	13 42
8	16 35	16 28	16 22	16 15	16 07	15 58	15 49	15 38	15 26	15 12	14 56	14 35	14 10	13 33
12	16 35	16 29	16 22	16 15	16 07	15 58	15 48	15 37	15 25	15 11	14 54	14 33	14 06	13 26
16	16 36	16 30	16 23	16 16	16 07	15 59	15 49	15 38	15 25	15 10	14 53	14 32	14 04	13 22
20	16 38	16 31	16 24	16 17	16 09	16 00	15 50	15 39	15 26	15 12	14 54	14 32	14 04	13 21
24	16 40	16 33	16 27	16 19	16 11	16 02	15 52	15 41	15 29	15 14	14 56	14 35	14 07	13 24
28	16 42	16 36	16 29	16 22	16 14	16 05	15 56	15 45	15 32	15 18	15 00	14 39	14 11	13 31
32	16 46	16 39	16 33	16 26	16 18	16 09	15 59	15 49	15 36	15 22	15 05	14 45	14 18	13 40
36	16 49	16 43	16 37	16 30	16 22	16 13	16 04	15 54	15 42	15 28	15 12	14 52	14 27	13 52

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 0	23 16	23 15	23 13	23 12	23 11	23 10	23 09	23 08	23 07	23 05	23 04	23 03	23 02	23 01
1	23 36	23 38	23 40	23 41	23 43	23 44	23 46	23 47	23 49	23 51	23 52	23 54	23 56	23 57
2	23 57	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
3	.. ..	0 02	0 07	0 11	0 14	0 17	0 22	0 27	0 31	0 36	0 40	0 46	0 49	0 53
4	0 19	0 28	0 36	0 42	0 47	0 52	1 00	1 08	1 15	1 22	1 29	1 38	1 43	1 48
5	0 44	0 56	1 07	1 15	1 23	1 29	1 40	1 50	2 00	2 09	2 19	2 30	2 37	2 45
6	1 13	1 29	1 42	1 52	2 01	2 09	2 23	2 35	2 46	2 58	3 10	3 24	3 32	3 42
7	1 48	2 07	2 22	2 34	2 44	2 53	3 09	3 23	3 36	3 49	4 03	4 19	4 28	4 39
8	2 32	2 52	3 08	3 21	3 32	3 42	3 59	4 14	4 27	4 41	4 56	5 13	5 23	5 34
9	3 24	3 45	4 01	4 14	4 25	4 35	4 52	5 07	5 21	5 35	5 50	6 07	6 17	6 28
10	4 26	4 45	5 00	5 13	5 23	5 33	5 49	6 02	6 15	6 28	6 42	6 58	7 08	7 18
11	5 36	5 52	6 05	6 16	6 25	6 33	6 47	6 59	7 10	7 22	7 34	7 47	7 55	8 04
12	6 51	7 03	7 13	7 22	7 29	7 35	7 46	7 56	8 04	8 13	8 23	8 34	8 40	8 47
13	8 09	8 17	8 24	8 29	8 34	8 38	8 45	8 52	8 58	9 04	9 10	9 17	9 21	9 26
14	9 28	9 32	9 35	9 37	9 39	9 41	9 45	9 47	9 50	9 53	9 56	9 59	10 01	10 03
15	10 48	10 47	10 46	10 45	10 45	10 44	10 43	10 43	10 42	10 41	10 41	10 40	10 39	10 39
16	12 08	12 02	11 57	11 53	11 50	11 47	11 42	11 38	11 34	11 30	11 26	11 21	11 18	11 15
17	13 26	13 16	13 08	13 01	12 55	12 50	12 41	12 33	12 26	12 19	12 12	12 03	11 58	11 53
18	14 43	14 29	14 17	14 08	14 00	13 52	13 40	13 30	13 20	13 10	12 59	12 47	12 41	12 33
19	15 57	15 39	15 24	15 13	15 03	14 54	14 39	14 26	14 14	14 02	13 49	13 35	13 26	13 17
20	17 04	16 44	16 28	16 15	16 04	15 54	15 37	15 23	15 10	14 56	14 42	14 25	14 16	14 05
21	18 03	17 42	17 26	17 12	17 01	16 51	16 34	16 19	16 05	15 51	15 36	15 19	15 09	14 58
22	18 53	18 33	18 17	18 05	17 54	17 44	17 27	17 13	16 59	16 46	16 32	16 15	16 05	15 54
23	19 34	19 16	19 02	18 51	18 41	18 32	18 18	18 05	17 52	17 40	17 27	17 12	17 03	16 53
24	20 07	19 53	19 42	19 32	19 24	19 17	19 04	18 53	18 43	18 33	18 21	18 09	18 02	17 55

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 0	10 23	10 27	10 30	10 32	10 34	10 36	10 39	10 42	10 44	10 47	10 50	10 53	10 54	10 56
1	11 29	11 29	11 28	11 28	11 28	11 28	11 28	11 27	11 27	11 27	11 27	11 26	11 26	11 26
2	12 34	12 30	12 27	12 24	12 21	12 19	12 16	12 12	12 09	12 06	12 03	12 00	11 57	11 55
3	13 39	13 31	13 25	13 19	13 15	13 11	13 04	12 58	12 52	12 46	12 40	12 34	12 30	12 25
4	14 44	14 32	14 23	14 15	14 09	14 03	13 53	13 44	13 36	13 28	13 19	13 09	13 04	12 57
5	15 49	15 34	15 22	15 12	15 04	14 56	14 43	14 32	14 22	14 11	14 00	13 48	13 40	13 32
6	16 53	16 35	16 21	16 09	15 59	15 50	15 35	15 22	15 10	14 58	14 45	14 30	14 21	14 11
7	17 54	17 34	17 18	17 05	16 54	16 45	16 28	16 14	16 00	15 47	15 32	15 16	15 06	14 55
8	18 50	18 29	18 13	18 00	17 49	17 39	17 22	17 07	16 53	16 39	16 24	16 07	15 57	15 45
9	19 40	19 20	19 05	18 52	18 41	18 31	18 15	18 00	17 47	17 33	17 19	17 02	16 52	16 41
10	20 23	20 05	19 51	19 40	19 30	19 22	19 07	18 54	18 42	18 29	18 16	18 01	17 52	17 42
11	20 59	20 45	20 34	20 24	20 16	20 09	19 57	19 46	19 36	19 26	19 15	19 02	18 55	18 47
12	21 30	21 20	21 12	21 05	20 59	20 54	20 45	20 37	20 30	20 22	20 14	20 05	20 00	19 54
13	21 57	21 51	21 47	21 43	21 40	21 37	21 32	21 27	21 23	21 18	21 14	21 08	21 05	21 02
14	22 22	22 21	22 20	22 19	22 19	22 18	22 17	22 16	22 15	22 14	22 13	22 11	22 11	22 10
15	22 47	22 50	22 53	22 55	22 57	22 59	23 02	23 04	23 07	23 09	23 11	23 14	23 16	23 18
16	23 13	23 21	23 27	23 32	23 36	23 40	23 47	23 53	23 59	.. ..	.. ..	.. ..	.. ..	.. ..
17	23 42	23 53	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 04	0 10	0 17	0 21	0 26
18	.. ..	.. ..	0 03	0 11	0 17	0 23	0 34	0 43	0 52	1 00	1 09	1 20	1 26	1 33
19	0 14	0 30	0 42	0 53	1 02	1 09	1 23	1 35	1 46	1 57	2 08	2 22	2 30	2 39
20	0 53	1 12	1 27	1 39	1 49	1 58	2 14	2 28	2 41	2 53	3 07	3 23	3 32	3 43
21	1 39	2 00	2 16	2 29	2 41	2 51	3 07	3 22	3 36	3 50	4 05	4 22	4 31	4 43
22	2 34	2 55	3 11	3 24	3 36	3 46	4 03	4 17	4 31	4 45	5 00	5 17	5 26	5 38
23	3 35	3 54	4 10	4 22	4 33	4 42	4 58	5 12	5 25	5 38	5 52	6 07	6 17	6 27
24	4 41	4 58	5 11	5 22	5 31	5 39	5 53	6 05	6 17	6 28	6 40	6 54	7 02	7 11

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 0	23 01	23 01	23 00	23 00	22 59	22 59	22 58	22 58	22 57	22 56	22 55	22 54	22 53	22 52
1	23 57	23 58	23 58	23 59	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
2	.. ..	.. ..	.. ..	.. ..	0 00	0 00	0 01	0 02	0 03	0 04	0 06	0 07	0 09	0 11
3	0 53	0 54	0 56	0 58	1 00	1 02	1 04	1 06	1 09	1 12	1 16	1 20	1 24	1 30
4	1 48	1 51	1 54	1 56	2 00	2 03	2 07	2 11	2 15	2 20	2 26	2 32	2 40	2 49
5	2 45	2 48	2 52	2 56	3 00	3 05	3 10	3 15	3 21	3 28	3 36	3 45	3 56	4 08
6	3 42	3 46	3 50	3 55	4 00	4 06	4 12	4 19	4 27	4 35	4 45	4 57	5 10	5 27
7	4 39	4 43	4 48	4 54	5 00	5 06	5 13	5 21	5 30	5 40	5 52	6 06	6 22	6 42
8	5 34	5 39	5 45	5 51	5 57	6 04	6 12	6 20	6 30	6 41	6 53	7 08	7 26	7 48
9	6 28	6 33	6 38	6 44	6 50	6 57	7 05	7 14	7 23	7 34	7 46	8 01	8 18	8 40
10	7 18	7 23	7 28	7 33	7 39	7 45	7 52	8 00	8 09	8 19	8 30	8 43	8 58	9 17
11	8 04	8 08	8 13	8 17	8 22	8 28	8 34	8 40	8 47	8 55	9 05	9 15	9 28	9 43
12	8 47	8 50	8 53	8 57	9 01	9 05	9 09	9 14	9 20	9 26	9 33	9 41	9 50	10 00
13	9 26	9 28	9 30	9 33	9 35	9 38	9 41	9 44	9 48	9 52	9 56	10 01	10 07	10 14
14	10 03	10 04	10 05	10 06	10 07	10 08	10 10	10 11	10 13	10 15	10 17	10 19	10 21	10 24
15	10 39	10 39	10 38	10 38	10 38	10 38	10 37	10 37	10 37	10 36	10 36	10 35	10 35	10 34
16	11 15	11 14	11 12	11 11	11 09	11 07	11 05	11 03	11 01	10 58	10 56	10 52	10 49	10 45
17	11 53	11 50	11 48	11 45	11 42	11 39	11 35	11 31	11 27	11 22	11 17	11 11	11 04	10 56
18	12 33	12 29	12 26	12 22	12 18	12 13	12 08	12 03	11 56	11 50	11 42	11 33	11 23	11 11
19	13 17	13 13	13 08	13 03	12 58	12 52	12 46	12 39	12 31	12 23	12 13	12 01	11 48	11 32
20	14 05	14 00	13 55	13 50	13 44	13 37	13 30	13 22	13 13	13 03	12 51	12 38	12 22	12 02
21	14 58	14 53	14 48	14 42	14 35	14 28	14 21	14 12	14 03	13 52	13 40	13 25	13 08	12 46
22	15 54	15 50	15 44	15 39	15 33	15 26	15 18	15 10	15 01	14 51	14 39	14 25	14 08	13 47
23	16 53	16 49	16 44	16 39	16 34	16 28	16 21	16 14	16 05	15 56	15 46	15 33	15 18	15 01
24	17 53	17 50	17 46	17 41	17 37	17 32	17 26	17 20	17 13	17 06	16 57	16 47	16 36	16 22

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 0	10 56	10 57	10 58	10 59	11 00	11 01	11 03	11 04	11 05	11 07	11 09	11 11	11 13	11 16
1	11 26	11 26	11 26	11 26	11 25	11 25	11 25	11 25	11 25	11 25	11 24	11 24	11 24	11 24
2	11 55	11 54	11 53	11 52	11 50	11 49	11 48	11 46	11 44	11 42	11 40	11 37	11 34	11 31
3	12 25	12 23	12 21	12 19	12 16	12 14	12 11	12 08	12 04	12 01	11 56	11 51	11 46	11 40
4	12 57	12 54	12 51	12 48	12 44	12 41	12 36	12 32	12 27	12 21	12 15	12 08	11 59	11 50
5	13 32	13 28	13 24	13 20	13 16	13 11	13 05	12 59	12 53	12 45	12 37	12 27	12 16	12 03
6	14 11	14 07	14 02	13 57	13 52	13 46	13 39	13 32	13 24	13 15	13 05	12 53	12 39	12 21
7	14 55	14 50	14 45	14 40	14 33	14 27	14 19	14 11	14 02	13 52	13 40	13 26	13 10	12 49
8	15 45	15 40	15 35	15 29	15 22	15 15	15 08	14 59	14 50	14 39	14 26	14 11	13 53	13 31
9	16 41	16 36	16 31	16 25	16 19	16 12	16 05	15 56	15 47	15 36	15 24	15 09	14 52	14 30
10	17 42	17 38	17 33	17 28	17 22	17 16	17 09	17 02	16 53	16 44	16 33	16 20	16 05	15 46
11	18 47	18 43	18 39	18 35	18 30	18 25	18 20	18 14	18 07	17 59	17 50	17 40	17 29	17 14
12	19 54	19 51	19 48	19 45	19 42	19 38	19 34	19 30	19 25	19 19	19 13	19 06	18 58	18 48
13	21 02	21 00	20 58	20 57	20 55	20 52	20 50	20 48	20 45	20 42	20 38	20 34	20 30	20 24
14	22 10	22 09	22 09	22 08	22 08	22 07	22 07	22 06	22 06	22 05	22 04	22 03	22 02	22 01
15	23 18	23 19	23 19	23 20	23 21	23 22	23 24	23 25	23 26	23 28	23 30	23 32	23 34	23 37
16	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
17	0 26	0 28	0 30	0 32	0 34	0 37	0 40	0 43	0 47	0 51	0 55	1 00	1 06	1 12
18	1 33	1 36	1 39	1 43	1 46	1 51	1 55	2 00	2 06	2 12	2 19	2 27	2 36	2 47
19	2 39	2 43	2 47	2 52	2 57	3 02	3 08	3 15	3 22	3 30	3 39	3 50	4 03	4 19
20	3 43	3 47	3 52	3 58	4 03	4 10	4 17	4 25	4 33	4 43	4 54	5 08	5 23	5 43
21	4 43	4 48	4 53	4 59	5 05	5 12	5 19	5 28	5 37	5 48	6 00	6 15	6 32	6 54
22	5 38	5 43	5 48	5 54	6 00	6 07	6 14	6 22	6 32	6 42	6 54	7 09	7 26	7 47
23	6 27	6 32	6 37	6 42	6 48	6 54	7 01	7 08	7 17	7 26	7 37	7 50	8 05	8 23
24	7 11	7 15	7 19	7 24	7 28	7 34	7 40	7 46	7 53	8 01	8 10	8 21	8 33	8 48

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	19 34	19 16	19 02	18 51	18 41	18 32	18 18	18 05	17 52	17 40	17 27	17 12	17 03	16 53
24	20 07	19 53	19 42	19 32	19 24	19 17	19 04	18 53	18 43	18 33	18 21	18 09	18 02	17 53
25	20 35	20 25	20 16	20 09	20 02	19 57	19 47	19 39	19 31	19 23	19 15	19 05	18 59	18 53
26	20 59	20 52	20 47	20 42	20 38	20 34	20 28	20 22	20 17	20 12	20 06	19 59	19 56	19 52
27	21 21	21 18	21 15	21 13	21 11	21 09	21 06	21 03	21 01	20 58	20 56	20 53	20 51	20 49
28	21 42	21 42	21 42	21 42	21 43	21 43	21 43	21 44	21 44	21 44	21 44	21 45	21 45	21 45
29	22 02	22 06	22 09	22 12	22 14	22 16	22 20	22 23	22 26	22 29	22 33	22 37	22 39	22 41
30	22 23	22 31	22 37	22 42	22 46	22 50	22 57	23 03	23 09	23 15	23 21	23 28	23 32	23 37
31	22 47	22 58	23 06	23 14	23 20	23 26	23 36	23 45	23 53	...	...	...	...	...
Feb. 1	23 13	23 28	23 39	23 49	23 57	...	...	...	...	0 01	0 10	0 20	0 26	0 32
2	23 45	...	...	...	...	0 04	0 17	0 28	0 38	0 48	1 00	1 12	1 20	1 28
3	...	0 02	0 16	0 27	0 37	0 46	1 00	1 13	1 25	1 38	1 51	2 06	2 14	2 24
4	0 24	0 43	0 58	1 11	1 22	1 31	1 47	2 02	2 15	2 29	2 43	2 59	3 09	3 20
5	1 11	1 31	1 47	2 01	2 12	2 22	2 38	2 53	3 07	3 21	3 36	3 53	4 03	4 14
6	2 08	2 28	2 43	2 56	3 07	3 17	3 33	3 48	4 01	4 15	4 29	4 45	4 55	5 06
7	3 14	3 32	3 46	3 57	4 07	4 16	4 31	4 44	4 56	5 08	5 21	5 36	5 45	5 55
8	4 27	4 42	4 54	5 03	5 11	5 18	5 31	5 42	5 52	6 02	6 12	6 25	6 32	6 40
9	5 46	5 57	6 05	6 12	6 18	6 23	6 32	6 40	6 47	6 54	7 02	7 11	7 16	7 22
10	7 08	7 13	7 18	7 22	7 25	7 28	7 33	7 37	7 41	7 46	7 50	7 55	7 58	8 01
11	8 30	8 31	8 32	8 32	8 33	8 33	8 34	8 35	8 35	8 36	8 37	8 38	8 38	8 39
12	9 52	9 48	9 45	9 42	9 40	9 38	9 35	9 32	9 29	9 26	9 23	9 20	9 18	9 16
13	11 13	11 05	10 58	10 52	10 47	10 43	10 35	10 29	10 22	10 16	10 10	10 03	9 59	9 54
14	12 32	12 19	12 09	12 00	11 53	11 46	11 35	11 25	11 16	11 07	10 58	10 47	10 41	10 34
15	13 47	13 30	13 17	13 06	12 56	12 48	12 34	12 22	12 11	11 59	11 47	11 34	11 26	11 17
16	14 56	14 36	14 21	14 08	13 58	13 48	13 32	13 18	13 05	12 52	12 39	12 23	12 14	12 03

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	3 35	3 54	4 10	4 22	4 33	4 42	4 58	5 12	5 25	5 38	5 52	6 07	6 17	6 27
24	4 41	4 58	5 11	5 22	5 31	5 39	5 53	6 05	6 17	6 28	6 40	6 54	7 02	7 11
25	5 49	6 03	6 13	6 22	6 29	6 36	6 47	6 57	7 06	7 15	7 25	7 36	7 42	7 50
26	6 58	7 07	7 15	7 21	7 27	7 31	7 39	7 47	7 53	8 00	8 07	8 15	8 19	8 24
27	8 06	8 11	8 16	8 19	8 22	8 25	8 30	8 34	8 38	8 42	8 46	8 51	8 53	8 56
28	9 12	9 14	9 15	9 16	9 17	9 18	9 19	9 21	9 22	9 23	9 24	9 25	9 26	9 27
29	10 18	10 16	10 14	10 12	10 11	10 10	10 08	10 06	10 04	10 03	10 01	9 59	9 57	9 56
30	11 23	11 17	11 12	11 08	11 04	11 01	10 56	10 51	10 47	10 42	10 38	10 32	10 29	10 26
31	12 28	12 18	12 10	12 04	11 58	11 53	11 44	11 37	11 30	11 23	11 16	11 07	11 02	10 57
Feb. 1	13 32	13 19	13 08	12 59	12 52	12 45	12 34	12 24	12 14	12 05	11 55	11 44	11 37	11 30
2	14 36	14 19	14 06	13 55	13 46	13 38	13 24	13 12	13 01	12 49	12 37	12 23	12 15	12 06
3	15 37	15 18	15 03	14 51	14 40	14 31	14 16	14 02	13 49	13 36	13 22	13 07	12 58	12 47
4	16 35	16 15	15 59	15 46	15 35	15 25	15 08	14 54	14 40	14 26	14 11	13 55	13 45	13 34
5	17 28	17 08	16 52	16 39	16 28	16 18	16 01	15 47	15 33	15 19	15 04	14 47	14 37	14 26
6	18 15	17 56	17 41	17 29	17 19	17 10	16 54	16 40	16 27	16 14	16 00	15 44	15 35	15 24
7	18 54	18 39	18 26	18 16	18 07	17 59	17 46	17 34	17 23	17 11	16 59	16 45	16 37	16 28
8	19 29	19 17	19 07	18 59	18 53	18 47	18 36	18 27	18 18	18 09	18 00	17 49	17 43	17 35
9	19 59	19 51	19 45	19 40	19 35	19 32	19 25	19 19	19 13	19 07	19 01	18 54	18 50	18 45
10	20 26	20 23	20 20	20 18	20 16	20 15	20 12	20 09	20 07	20 05	20 02	19 59	19 57	19 55
11	20 52	20 53	20 55	20 56	20 56	20 57	20 59	21 00	21 01	21 02	21 03	21 04	21 05	21 06
12	21 18	21 24	21 29	21 33	21 37	21 40	21 45	21 50	21 54	21 59	22 04	22 09	22 12	22 16
13	21 46	21 57	22 05	22 12	22 18	22 23	22 32	22 40	22 48	22 56	23 04	23 13	23 18	23 24
14	22 18	22 32	22 44	22 53	23 01	23 09	23 21	23 32	23 42	23 52	...	...	...	...
15	22 55	23 12	23 26	23 38	23 48	23 56	...	...	...	...	0 03	0 16	0 23	0 32
16	23 38	23 58	...	...	...	...	0 11	0 25	0 37	0 49	1 02	1 17	1 26	1 36

... .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	16 53	16 49	16 44	16 39	16 34	16 28	16 21	16 14	16 05	15 56	15 46	15 33	15 18	15 01
24	17 53	17 50	17 46	17 41	17 37	17 32	17 26	17 20	17 13	17 06	16 57	16 47	16 36	16 22
25	18 53	18 50	18 47	18 44	18 40	18 37	18 32	18 28	18 23	18 17	18 11	18 03	17 55	17 45
26	19 52	19 50	19 48	19 46	19 43	19 41	19 38	19 35	19 32	19 28	19 24	19 19	19 14	19 08
27	20 49	20 48	20 47	20 46	20 45	20 44	20 43	20 41	20 40	20 38	20 36	20 34	20 32	20 29
28	21 45	21 46	21 46	21 46	21 46	21 46	21 46	21 47	21 47	21 47	21 47	21 48	21 48	21 49
29	22 41	22 42	22 44	22 45	22 46	22 48	22 49	22 51	22 53	22 55	22 58	23 00	23 04	23 07
30	23 37	23 39	23 41	23 43	23 46	23 49	23 52	23 55	23 59	.. ..	.. ..	.. ..	.. ..	.. ..
31	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 03	0 07	0 13	0 19	0 26
Feb. 1	0 32	0 35	0 39	0 42	0 46	0 50	0 54	0 59	1 04	1 10	1 17	1 25	1 34	1 44
2	1 28	1 32	1 36	1 40	1 45	1 50	1 56	2 02	2 09	2 17	2 26	2 36	2 48	3 02
3	2 24	2 29	2 34	2 39	2 44	2 50	2 57	3 04	3 13	3 22	3 33	3 45	4 00	4 18
4	3 20	3 25	3 30	3 36	3 42	3 49	3 56	4 04	4 13	4 24	4 36	4 50	5 07	5 28
5	4 14	4 19	4 25	4 31	4 37	4 44	4 51	5 00	5 10	5 20	5 33	5 48	6 05	6 28
6	5 06	5 11	5 16	5 22	5 28	5 35	5 42	5 50	5 59	6 09	6 21	6 35	6 52	7 12
7	5 55	5 59	6 04	6 09	6 14	6 20	6 27	6 34	6 42	6 51	7 01	7 13	7 27	7 44
8	6 40	6 43	6 47	6 51	6 56	7 00	7 06	7 11	7 18	7 25	7 33	7 42	7 53	8 05
9	7 22	7 24	7 27	7 30	7 33	7 36	7 40	7 44	7 49	7 54	7 59	8 06	8 13	8 21
10	8 01	8 02	8 04	8 06	8 07	8 09	8 11	8 14	8 16	8 19	8 22	8 25	8 29	8 34
11	8 39	8 39	8 39	8 40	8 40	8 40	8 41	8 41	8 41	8 42	8 42	8 43	8 44	8 45
12	9 16	9 15	9 14	9 13	9 12	9 11	9 09	9 08	9 06	9 05	9 03	9 01	8 58	8 55
13	9 54	9 52	9 50	9 47	9 45	9 42	9 39	9 36	9 32	9 29	9 24	9 19	9 13	9 07
14	10 34	10 31	10 28	10 24	10 20	10 16	10 12	10 07	10 01	9 55	9 48	9 40	9 32	9 21
15	11 17	11 13	11 09	11 04	10 59	10 54	10 48	10 41	10 34	10 26	10 17	10 07	9 54	9 40
16	12 03	11 59	11 54	11 48	11 43	11 36	11 30	11 22	11 13	11 04	10 53	10 40	10 25	10 07

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	6 27	6 32	6 37	6 42	6 48	6 54	7 01	7 08	7 17	7 26	7 37	7 50	8 05	8 23
24	7 11	7 15	7 19	7 24	7 28	7 34	7 40	7 46	7 53	8 01	8 10	8 21	8 33	8 48
25	7 50	7 53	7 56	8 00	8 04	8 08	8 12	8 18	8 23	8 29	8 36	8 44	8 54	9 05
26	8 24	8 27	8 29	8 32	8 34	8 37	8 41	8 44	8 48	8 53	8 58	9 03	9 09	9 17
27	8 56	8 58	8 59	9 01	9 02	9 04	9 06	9 08	9 10	9 13	9 16	9 19	9 22	9 26
28	9 27	9 27	9 27	9 28	9 28	9 29	9 29	9 30	9 30	9 31	9 32	9 33	9 34	9 35
29	9 56	9 56	9 55	9 54	9 53	9 53	9 52	9 51	9 50	9 49	9 47	9 46	9 44	9 42
30	10 26	10 24	10 23	10 21	10 19	10 17	10 15	10 12	10 10	10 07	10 03	10 00	9 55	9 51
31	10 57	10 54	10 52	10 49	10 46	10 43	10 39	10 35	10 31	10 26	10 21	10 15	10 08	10 00
Feb. 1	11 30	11 26	11 23	11 19	11 15	11 11	11 06	11 01	10 55	10 48	10 41	10 33	10 23	10 11
2	12 06	12 02	11 58	11 53	11 48	11 43	11 37	11 30	11 23	11 15	11 06	10 55	10 42	10 27
3	12 47	12 43	12 38	12 32	12 27	12 20	12 13	12 06	11 57	11 48	11 36	11 24	11 08	10 50
4	13 34	13 29	13 23	13 18	13 11	13 04	12 57	12 49	12 39	12 29	12 16	12 02	11 45	11 23
5	14 26	14 21	14 16	14 10	14 03	13 56	13 49	13 40	13 31	13 20	13 08	12 53	12 35	12 13
6	15 24	15 20	15 15	15 09	15 03	14 57	14 49	14 42	14 33	14 22	14 11	13 57	13 41	13 21
7	16 28	16 24	16 19	16 15	16 10	16 04	15 58	15 51	15 43	15 35	15 25	15 14	15 00	14 44
8	17 35	17 32	17 29	17 25	17 21	17 17	17 12	17 07	17 01	16 54	16 47	16 39	16 29	16 17
9	18 45	18 43	18 41	18 38	18 36	18 33	18 30	18 26	18 23	18 18	18 14	18 08	18 02	17 55
10	19 55	19 54	19 53	19 52	19 51	19 50	19 49	19 47	19 46	19 44	19 42	19 40	19 37	19 34
11	21 06	21 06	21 06	21 07	21 07	21 08	21 08	21 09	21 09	21 10	21 11	21 12	21 13	21 14
12	22 16	22 17	22 19	22 21	22 23	22 25	22 27	22 29	22 32	22 35	22 39	22 43	22 47	22 52
13	23 24	23 27	23 30	23 33	23 36	23 40	23 44	23 48	23 53	23 59	.. ..	.. ..	.. ..	.. ..
14	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 05	0 12	0 20	0 29
15	0 32	0 35	0 39	0 43	0 48	0 53	0 58	1 04	1 11	1 19	1 27	1 37	1 49	2 03
16	1 36	1 40	1 45	1 50	1 56	2 02	2 08	2 16	2 24	2 33	2 44	2 56	3 11	3 29

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	13 47	13 30	13 17	13 06	12 56	12 48	12 34	12 22	12 11	11 59	11 47	11 34	11 26	11 17
16	14 56	14 36	14 21	14 08	13 58	13 48	13 32	13 18	13 05	12 52	12 39	12 23	12 14	12 03
17	15 57	15 36	15 20	15 07	14 55	14 45	14 28	14 14	14 00	13 46	13 32	13 15	13 05	12 54
18	16 49	16 29	16 13	16 00	15 48	15 39	15 22	15 07	14 54	14 40	14 25	14 09	13 59	13 48
19	17 32	17 14	16 59	16 47	16 37	16 28	16 12	15 59	15 46	15 33	15 20	15 04	14 55	14 45
20	18 08	17 52	17 40	17 29	17 21	17 13	16 59	16 48	16 37	16 25	16 14	16 00	15 52	15 43
21	18 37	18 25	18 15	18 07	18 00	17 54	17 43	17 34	17 25	17 16	17 07	16 56	16 49	16 42
22	19 03	18 54	18 47	18 42	18 36	18 32	18 24	18 18	18 11	18 05	17 58	17 50	17 46	17 41
23	19 25	19 21	19 17	19 13	19 10	19 08	19 03	19 00	18 56	18 52	18 48	18 44	18 41	18 38
24	19 46	19 45	19 44	19 43	19 43	19 42	19 41	19 40	19 39	19 38	19 38	19 37	19 36	19 35
25	20 07	20 09	20 11	20 13	20 14	20 16	20 18	20 20	20 22	20 24	20 26	20 29	20 30	20 31
26	20 28	20 34	20 39	20 43	20 46	20 50	20 55	21 00	21 05	21 09	21 14	21 20	21 23	21 27
27	20 50	21 00	21 07	21 14	21 20	21 25	21 33	21 41	21 48	21 55	22 03	22 12	22 17	22 23
28	21 15	21 28	21 39	21 47	21 55	22 01	22 13	22 23	22 32	22 42	22 52	23 03	23 10	23 18
29	21 44	22 00	22 13	22 24	22 33	22 41	22 54	23 07	23 18	23 29	23 42	23 56	.. ..	.. ..
Mar. 1	22 19	22 38	22 52	23 04	23 14	23 23	23 39	23 53	.. ..	.. ..	.. ..	.. ..	0 04	0 13
2	23 01	23 21	23 37	23 50	.. ..	.. ..	.. ..	.. ..	0 06	0 18	0 32	0 48	0 57	1 08
3	23 52	.. ..	.. ..	.. ..	0 01	0 10	0 27	0 42	0 55	1 09	1 24	1 40	1 50	2 01
4	.. ..	0 12	0 28	0 41	0 52	1 02	1 19	1 33	1 47	2 01	2 15	2 32	2 42	2 53
5	0 52	1 11	1 26	1 38	1 49	1 58	2 14	2 28	2 40	2 53	3 07	3 23	3 32	3 42
6	2 01	2 17	2 30	2 41	2 50	2 58	3 12	3 24	3 35	3 46	3 58	4 12	4 20	4 29
7	3 17	3 29	3 39	3 48	3 55	4 01	4 12	4 21	4 30	4 39	4 48	4 59	5 05	5 12
8	4 38	4 46	4 52	4 58	5 02	5 06	5 13	5 19	5 25	5 31	5 37	5 44	5 48	5 53
9	6 01	6 04	6 07	6 09	6 11	6 13	6 16	6 18	6 21	6 23	6 26	6 29	6 30	6 32
10	7 26	7 24	7 23	7 22	7 21	7 20	7 18	7 17	7 16	7 15	7 14	7 12	7 12	7 11

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	22 55	23 12	23 26	23 38	23 48	23 56	.. ..	.. ..	.. ..	.. ..	0 03	0 16	0 23	0 32
16	23 38	23 58	.. ..	.. ..	.. ..	.. ..	0 11	0 25	0 37	0 49	1 02	1 17	1 26	1 36
17	.. ..	.. ..	0 14	0 27	0 37	0 47	1 04	1 18	1 32	1 45	1 59	2 16	2 26	2 37
18	0 29	0 49	1 06	1 19	1 30	1 40	1 57	2 12	2 26	2 40	2 54	3 11	3 21	3 32
19	1 26	1 46	2 02	2 15	2 26	2 35	2 52	3 06	3 19	3 32	3 46	4 03	4 12	4 23
20	2 29	2 47	3 01	3 13	3 22	3 31	3 46	3 59	4 11	4 23	4 35	4 50	4 58	5 08
21	3 36	3 50	4 02	4 12	4 20	4 27	4 39	4 50	5 00	5 10	5 21	5 33	5 40	5 48
22	4 43	4 54	5 03	5 10	5 17	5 22	5 32	5 40	5 47	5 55	6 03	6 12	6 18	6 24
23	5 51	5 58	6 04	6 09	6 13	6 16	6 22	6 28	6 33	6 38	6 43	6 49	6 53	6 57
24	6 58	7 01	7 04	7 06	7 08	7 09	7 12	7 15	7 17	7 19	7 22	7 24	7 26	7 27
25	8 04	8 04	8 03	8 02	8 02	8 02	8 01	8 01	8 00	7 59	7 59	7 58	7 58	7 57
26	9 10	9 05	9 01	8 58	8 56	8 53	8 49	8 46	8 43	8 39	8 36	8 32	8 29	8 27
27	10 14	10 06	9 59	9 54	9 49	9 45	9 38	9 31	9 25	9 20	9 13	9 06	9 02	8 57
28	11 18	11 07	10 57	10 49	10 43	10 37	10 26	10 17	10 09	10 01	9 52	9 42	9 36	9 29
29	12 22	12 06	11 54	11 44	11 36	11 29	11 16	11 04	10 54	10 43	10 32	10 20	10 12	10 04
Mar. 1	13 23	13 05	12 51	12 39	12 29	12 21	12 06	11 53	11 41	11 28	11 15	11 01	10 52	10 42
2	14 21	14 02	13 46	13 33	13 23	13 13	12 57	12 43	12 29	12 16	12 02	11 45	11 36	11 25
3	15 16	14 55	14 39	14 26	14 15	14 05	13 48	13 34	13 20	13 06	12 51	12 34	12 25	12 13
4	16 04	15 45	15 29	15 17	15 06	14 56	14 40	14 26	14 12	13 59	13 45	13 28	13 18	13 07
5	16 46	16 29	16 16	16 04	15 55	15 46	15 31	15 18	15 06	14 54	14 41	14 26	14 17	14 07
6	17 23	17 09	16 58	16 49	16 41	16 34	16 22	16 11	16 01	15 51	15 40	15 28	15 20	15 12
7	17 55	17 45	17 38	17 31	17 25	17 20	17 11	17 04	16 56	16 49	16 41	16 32	16 26	16 20
8	18 24	18 19	18 15	18 11	18 08	18 05	18 00	17 56	17 52	17 47	17 43	17 38	17 35	17 31
9	18 51	18 51	18 50	18 50	18 49	18 49	18 48	18 47	18 47	18 46	18 45	18 45	18 44	18 44
10	19 19	19 22	19 26	19 28	19 31	19 33	19 36	19 39	19 42	19 45	19 48	19 52	19 54	19 56

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	11 17	11 13	11 09	11 04	10 59	10 54	10 48	10 41	10 34	10 26	10 17	10 07	9 54	9 40
16	12 03	11 59	11 54	11 48	11 43	11 36	11 30	11 22	11 13	11 04	10 53	10 40	10 25	10 07
17	12 54	12 49	12 44	12 38	12 32	12 25	12 17	12 09	12 00	11 49	11 37	11 23	11 06	10 45
18	13 48	13 43	13 38	13 32	13 26	13 19	13 12	13 03	12 54	12 44	12 31	12 17	12 00	11 39
19	14 45	14 40	14 35	14 30	14 24	14 18	14 11	14 03	13 55	13 45	13 34	13 21	13 06	12 47
20	15 43	15 39	15 35	15 31	15 26	15 20	15 14	15 08	15 00	14 52	14 43	14 32	14 19	14 04
21	16 42	16 39	16 36	16 32	16 28	16 24	16 19	16 14	16 08	16 02	15 55	15 46	15 36	15 25
22	17 41	17 38	17 36	17 33	17 31	17 28	17 24	17 21	17 17	17 12	17 07	17 02	16 55	16 47
23	18 38	18 37	18 36	18 34	18 33	18 31	18 29	18 27	18 25	18 22	18 20	18 16	18 13	18 09
24	19 35	19 35	19 35	19 34	19 34	19 34	19 33	19 33	19 32	19 32	19 31	19 30	19 30	19 29
25	20 31	20 32	20 33	20 34	20 35	20 36	20 37	20 38	20 39	20 40	20 42	20 44	20 46	20 48
26	21 27	21 29	21 31	21 33	21 35	21 37	21 39	21 42	21 45	21 48	21 52	21 56	22 01	22 07
27	22 23	22 25	22 28	22 31	22 34	22 38	22 41	22 46	22 50	22 55	23 01	23 08	23 16	23 25
28	23 18	23 21	23 25	23 29	23 33	23 38	23 43	23 49	23 55	.. ..	.. ..	.. ..	.. ..	.. ..
29	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 02	0 10	0 19	0 30	0 42
Mar. 1	0 13	0 17	0 22	0 26	0 32	0 37	0 44	0 50	0 58	1 07	1 17	1 28	1 42	1 58
2	1 08	1 12	1 17	1 23	1 29	1 35	1 42	1 50	1 59	2 09	2 20	2 34	2 50	3 10
3	2 01	2 06	2 12	2 17	2 24	2 31	2 38	2 47	2 56	3 07	3 19	3 33	3 51	4 13
4	2 53	2 58	3 03	3 09	3 15	3 22	3 30	3 38	3 47	3 58	4 10	4 25	4 42	5 03
5	3 42	3 47	3 52	3 57	4 03	4 09	4 16	4 24	4 33	4 42	4 53	5 06	5 22	5 40
6	4 29	4 33	4 37	4 42	4 46	4 52	4 58	5 04	5 11	5 20	5 29	5 39	5 52	6 06
7	5 12	5 15	5 18	5 22	5 26	5 30	5 34	5 39	5 45	5 51	5 58	6 06	6 15	6 25
8	5 53	5 55	5 57	5 59	6 02	6 05	6 07	6 11	6 14	6 18	6 22	6 27	6 33	6 40
9	6 32	6 33	6 34	6 35	6 36	6 37	6 38	6 40	6 41	6 43	6 44	6 47	6 49	6 52
10	7 11	7 10	7 10	7 10	7 09	7 09	7 08	7 08	7 07	7 06	7 06	7 05	7 04	7 03

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	0 32	0 35	0 39	0 43	0 48	0 53	0 58	1 04	1 11	1 19	1 27	1 37	1 49	2 03
16	1 36	1 40	1 45	1 50	1 56	2 02	2 08	2 16	2 24	2 33	2 44	2 56	3 11	3 29
17	2 37	2 41	2 47	2 52	2 58	3 05	3 12	3 21	3 30	3 40	3 52	4 06	4 23	4 44
18	3 32	3 37	3 43	3 48	3 55	4 01	4 09	4 17	4 27	4 37	4 49	5 04	5 21	5 42
19	4 23	4 27	4 32	4 38	4 44	4 50	4 57	5 05	5 14	5 24	5 35	5 49	6 04	6 24
20	5 08	5 12	5 16	5 21	5 26	5 32	5 38	5 45	5 53	6 01	6 11	6 23	6 36	6 52
21	5 48	5 51	5 55	5 59	6 03	6 08	6 13	6 18	6 25	6 32	6 39	6 48	6 59	7 11
22	6 24	6 26	6 29	6 32	6 35	6 39	6 43	6 47	6 51	6 56	7 02	7 09	7 16	7 25
23	6 57	6 58	7 00	7 02	7 04	7 06	7 09	7 11	7 14	7 18	7 21	7 25	7 30	7 36
24	7 27	7 28	7 29	7 30	7 31	7 32	7 33	7 34	7 35	7 37	7 38	7 40	7 42	7 44
25	7 57	7 57	7 57	7 57	7 56	7 56	7 56	7 55	7 55	7 55	7 54	7 54	7 53	7 53
26	8 27	8 26	8 25	8 23	8 22	8 20	8 19	8 17	8 15	8 13	8 10	8 07	8 04	8 01
27	8 57	8 55	8 53	8 51	8 48	8 45	8 42	8 39	8 36	8 32	8 27	8 22	8 16	8 10
28	9 29	9 26	9 23	9 20	9 16	9 12	9 08	9 03	8 58	8 53	8 46	8 39	8 30	8 20
29	10 04	10 00	9 56	9 52	9 47	9 42	9 37	9 31	9 24	9 17	9 08	8 59	8 47	8 34
Mar. 1	10 42	10 38	10 33	10 28	10 23	10 17	10 10	10 03	9 55	9 46	9 36	9 24	9 10	8 53
2	11 25	11 20	11 15	11 09	11 03	10 57	10 50	10 42	10 33	10 22	10 11	9 57	9 41	9 21
3	12 13	12 08	12 03	11 57	11 51	11 44	11 36	11 28	11 18	11 08	10 55	10 41	10 23	10 01
4	13 07	13 03	12 57	12 52	12 46	12 39	12 31	12 23	12 14	12 03	11 51	11 37	11 20	10 59
5	14 07	14 03	13 58	13 53	13 47	13 41	13 35	13 27	13 19	13 09	12 59	12 46	12 31	12 13
6	15 12	15 08	15 04	15 00	14 56	14 51	14 45	14 39	14 32	14 25	14 16	14 06	13 54	13 40
7	16 20	16 18	16 15	16 12	16 08	16 05	16 01	15 57	15 52	15 46	15 40	15 33	15 25	15 16
8	17 31	17 30	17 28	17 26	17 25	17 23	17 20	17 18	17 15	17 12	17 09	17 05	17 01	16 55
9	18 44	18 43	18 43	18 43	18 42	18 42	18 42	18 41	18 41	18 40	18 40	18 39	18 38	18 37
10	19 56	19 57	19 58	19 59	20 01	20 02	20 03	20 05	20 07	20 09	20 11	20 14	20 16	20 20

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	6 01	6 04	6 07	6 09	6 11	6 13	6 16	6 18	6 21	6 23	6 26	6 29	6 30	6 32
10	7 26	7 24	7 23	7 22	7 21	7 20	7 18	7 17	7 16	7 15	7 14	7 12	7 12	7 11
11	8 51	8 44	8 39	8 34	8 30	8 27	8 21	8 16	8 12	8 07	8 02	7 57	7 53	7 50
12	10 14	10 02	9 53	9 46	9 39	9 34	9 24	9 15	9 08	9 00	8 51	8 42	8 37	8 30
13	11 33	11 17	11 05	10 55	10 46	10 39	10 26	10 14	10 04	9 53	9 42	9 29	9 22	9 14
14	12 46	12 27	12 13	12 01	11 50	11 41	11 26	11 12	11 00	10 47	10 34	10 19	10 10	10 00
15	13 51	13 31	13 15	13 01	12 50	12 41	12 24	12 09	11 56	11 42	11 28	11 11	11 02	10 51
16	14 46	14 26	14 10	13 57	13 45	13 36	13 19	13 04	12 50	12 36	12 22	12 05	11 55	11 44
17	15 32	15 13	14 58	14 45	14 35	14 26	14 10	13 56	13 43	13 30	13 16	13 00	12 51	12 40
18	16 10	15 53	15 40	15 29	15 20	15 12	14 58	14 45	14 34	14 22	14 10	13 55	13 47	13 38
19	16 41	16 27	16 17	16 08	16 00	15 54	15 42	15 32	15 22	15 12	15 02	14 50	14 44	14 36
20	17 07	16 57	16 49	16 43	16 37	16 32	16 23	16 16	16 08	16 01	15 54	15 45	15 40	15 34
21	17 30	17 24	17 19	17 15	17 11	17 08	17 03	16 58	16 53	16 49	16 44	16 38	16 35	16 31
22	17 52	17 49	17 47	17 45	17 44	17 43	17 40	17 38	17 37	17 35	17 33	17 31	17 29	17 28
23	18 12	18 13	18 14	18 15	18 16	18 16	18 17	18 18	18 19	18 20	18 21	18 23	18 23	18 24
24	18 33	18 37	18 41	18 45	18 47	18 50	18 54	18 58	19 02	19 06	19 10	19 14	19 17	19 20
25	18 54	19 03	19 09	19 15	19 20	19 24	19 32	19 39	19 45	19 51	19 58	20 06	20 10	20 15
26	19 18	19 30	19 40	19 48	19 54	20 00	20 11	20 20	20 29	20 37	20 47	20 58	21 04	21 11
27	19 46	20 01	20 13	20 23	20 31	20 39	20 52	21 03	21 14	21 25	21 36	21 49	21 57	22 06
28	20 18	20 36	20 50	21 01	21 11	21 20	21 35	21 48	22 00	22 13	22 26	22 41	22 50	23 00
29	20 56	21 16	21 31	21 44	21 55	22 04	22 21	22 35	22 48	23 02	23 16	23 33	23 42	23 53
30	21 42	22 03	22 19	22 32	22 43	22 53	23 10	23 24	23 38	23 52	.. ..	.. ..	.. ..	.. ..
31	22 37	22 57	23 12	23 25	23 36	23 45	.. ..	.. ..	.. ..	.. ..	0 07	0 24	0 34	0 45
Apr. 1	23 40	23 58	.. ..	.. ..	.. ..	.. ..	0 02	0 16	0 29	0 43	0 57	1 13	1 23	1 34
2	.. ..	.. ..	0 12	0 23	0 33	0 42	0 57	1 10	1 22	1 34	1 47	2 02	2 10	2 20

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	18 51	18 51	18 50	18 50	18 49	18 49	18 48	18 47	18 47	18 46	18 45	18 45	18 44	18 44
10	19 19	19 22	19 26	19 28	19 31	19 33	19 36	19 39	19 42	19 45	19 48	19 52	19 54	19 56
11	19 47	19 55	20 02	20 08	20 13	20 17	20 25	20 32	20 38	20 44	20 51	20 59	21 03	21 08
12	20 18	20 31	20 41	20 50	20 57	21 04	21 15	21 25	21 34	21 44	21 53	22 05	22 11	22 19
13	20 54	21 11	21 24	21 35	21 44	21 52	22 07	22 19	22 31	22 42	22 55	23 09	23 17	23 27
14	21 36	21 56	22 11	22 23	22 34	22 43	22 59	23 14	23 27	23 40	23 54	.. ..	.. ..	.. ..
15	22 25	22 46	23 02	23 15	23 27	23 36	23 53	.. ..	.. ..	.. ..	.. ..	0 10	0 19	0 30
16	23 21	23 41	23 57	.. ..	.. ..	.. ..	.. ..	0 08	0 22	0 36	0 50	1 07	1 17	1 28
17	.. ..	.. ..	.. ..	0 10	0 21	0 31	0 48	1 02	1 16	1 29	1 44	2 00	2 10	2 20
18	0 23	0 41	0 56	1 07	1 18	1 27	1 42	1 55	2 08	2 20	2 33	2 48	2 57	3 07
19	1 27	1 43	1 55	2 06	2 14	2 22	2 35	2 47	2 57	3 08	3 19	3 32	3 39	3 48
20	2 34	2 46	2 56	3 04	3 11	3 17	3 27	3 36	3 45	3 53	4 02	4 12	4 18	4 25
21	3 41	3 49	3 56	4 01	4 06	4 11	4 18	4 24	4 30	4 36	4 42	4 49	4 53	4 58
22	4 47	4 52	4 56	4 59	5 01	5 04	5 07	5 11	5 14	5 17	5 21	5 25	5 27	5 29
23	5 53	5 54	5 55	5 55	5 55	5 56	5 56	5 57	5 57	5 58	5 58	5 59	5 59	5 59
24	6 59	6 56	6 53	6 51	6 49	6 48	6 45	6 42	6 40	6 38	6 35	6 32	6 31	6 29
25	8 04	7 57	7 51	7 47	7 43	7 39	7 33	7 28	7 23	7 18	7 12	7 06	7 03	6 59
26	9 08	8 58	8 49	8 42	8 36	8 31	8 22	8 14	8 06	7 58	7 50	7 41	7 36	7 30
27	10 12	9 58	9 47	9 37	9 29	9 23	9 11	9 00	8 50	8 41	8 30	8 18	8 11	8 04
28	11 14	10 57	10 43	10 32	10 23	10 14	10 00	9 48	9 36	9 24	9 12	8 58	8 50	8 40
29	12 13	11 53	11 38	11 26	11 15	11 06	10 50	10 36	10 23	10 10	9 56	9 41	9 31	9 21
30	13 07	12 47	12 31	12 18	12 07	11 57	11 41	11 26	11 12	10 59	10 44	10 27	10 17	10 06
31	13 57	13 37	13 21	13 08	12 57	12 48	12 31	12 16	12 03	11 49	11 34	11 18	11 08	10 57
Apr. 1	14 41	14 22	14 08	13 56	13 45	13 36	13 21	13 07	12 54	12 42	12 28	12 12	12 03	11 52
2	15 19	15 03	14 51	14 40	14 31	14 24	14 10	13 58	13 47	13 36	13 24	13 10	13 02	12 53

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

39

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	6 32	6 33	6 34	6 35	6 36	6 37	6 38	6 40	6 41	6 43	6 44	6 47	6 49	6 52
10	7 11	7 10	7 10	7 10	7 09	7 09	7 08	7 08	7 07	7 06	7 06	7 05	7 04	7 03
11	7 50	7 48	7 47	7 45	7 43	7 41	7 39	7 36	7 34	7 31	7 27	7 24	7 19	7 14
12	8 30	8 28	8 25	8 22	8 19	8 15	8 11	8 07	8 02	7 57	7 51	7 45	7 37	7 28
13	9 14	9 10	9 06	9 02	8 57	8 53	8 47	8 41	8 35	8 27	8 19	8 10	7 59	7 46
14	10 00	9 56	9 51	9 46	9 41	9 35	9 28	9 21	9 13	9 04	8 53	8 41	8 27	8 10
15	10 51	10 46	10 40	10 35	10 29	10 22	10 15	10 07	9 58	9 47	9 36	9 22	9 05	8 45
16	11 44	11 39	11 34	11 28	11 22	11 15	11 08	10 59	10 50	10 39	10 27	10 13	9 56	9 34
17	12 40	12 35	12 30	12 25	12 19	12 13	12 06	11 58	11 49	11 39	11 27	11 14	10 58	10 38
18	13 38	13 34	13 29	13 24	13 19	13 13	13 07	13 00	12 53	12 44	12 34	12 22	12 09	11 52
19	14 36	14 32	14 29	14 25	14 21	14 16	14 11	14 05	13 59	13 52	13 44	13 35	13 24	13 11
20	15 34	15 31	15 29	15 26	15 22	15 19	15 15	15 11	15 06	15 01	14 56	14 49	14 41	14 32
21	16 31	16 30	16 28	16 26	16 24	16 22	16 19	16 17	16 14	16 11	16 07	16 03	15 59	15 53
22	17 28	17 27	17 27	17 26	17 25	17 24	17 23	17 22	17 21	17 20	17 19	17 17	17 15	17 13
23	18 24	18 24	18 25	18 25	18 26	18 26	18 27	18 27	18 28	18 29	18 29	18 30	18 31	18 32
24	19 20	19 21	19 23	19 24	19 26	19 28	19 29	19 32	19 34	19 37	19 40	19 43	19 47	19 51
25	20 15	20 18	20 20	20 23	20 26	20 29	20 32	20 36	20 40	20 44	20 49	20 55	21 02	21 10
26	21 11	21 14	21 17	21 21	21 25	21 29	21 34	21 39	21 45	21 51	21 58	22 06	22 16	22 27
27	22 06	22 10	22 14	22 18	22 23	22 29	22 35	22 41	22 48	22 56	23 05	23 16	23 29	23 44
28	23 00	23 05	23 10	23 15	23 21	23 27	23 34	23 41	23 49	23 59	.. ..	.. ..	.. ..	.. ..
29	23 53	23 58	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 10	0 23	0 38	0 57
30	.. ..	.. ..	0 04	0 09	0 16	0 22	0 30	0 38	0 47	0 58	1 10	1 24	1 41	2 02
31	0 45	0 50	0 55	1 01	1 07	1 14	1 22	1 30	1 40	1 51	2 03	2 18	2 35	2 57
Apr. 1	1 34	1 39	1 44	1 49	1 55	2 02	2 09	2 17	2 26	2 36	2 48	3 02	3 18	3 38
2	2 20	2 24	2 29	2 34	2 39	2 45	2 51	2 59	3 06	3 15	3 26	3 37	3 51	4 08

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	18 44	18 43	18 43	18 43	18 42	18 42	18 42	18 41	18 41	18 40	18 40	18 39	18 38	18 37
10	19 56	19 57	19 58	19 59	20 01	20 02	20 03	20 05	20 07	20 09	20 11	20 14	20 16	20 20
11	21 08	21 11	21 13	21 15	21 18	21 21	21 24	21 28	21 32	21 36	21 41	21 47	21 54	22 01
12	22 19	22 22	22 26	22 29	22 34	22 38	22 43	22 48	22 54	23 01	23 09	23 18	23 28	23 40
13	23 27	23 31	23 35	23 40	23 45	23 51	23 57	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
14	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 04	0 12	0 21	0 31	0 42	0 56	1 12
15	0 30	0 35	0 40	0 45	0 51	0 58	1 05	1 13	1 22	1 32	1 44	1 57	2 13	2 33
16	1 28	1 33	1 39	1 44	1 51	1 57	2 05	2 13	2 22	2 33	2 45	3 00	3 17	3 38
17	2 20	2 25	2 30	2 36	2 42	2 49	2 56	3 04	3 13	3 23	3 35	3 48	4 05	4 25
18	3 07	3 11	3 16	3 21	3 26	3 32	3 39	3 46	3 54	4 03	4 13	4 25	4 39	4 56
19	3 48	3 52	3 56	4 00	4 04	4 09	4 15	4 21	4 28	4 35	4 44	4 53	5 05	5 18
20	4 25	4 28	4 31	4 34	4 38	4 41	4 46	4 50	4 55	5 01	5 08	5 15	5 23	5 33
21	4 58	5 00	5 02	5 05	5 07	5 10	5 13	5 16	5 19	5 23	5 28	5 32	5 38	5 45
22	5 29	5 30	5 32	5 33	5 34	5 36	5 37	5 39	5 41	5 43	5 45	5 48	5 51	5 54
23	5 59	5 59	5 59	6 00	6 00	6 00	6 00	6 00	6 01	6 01	6 01	6 01	6 02	6 02
24	6 29	6 28	6 27	6 26	6 25	6 24	6 23	6 22	6 20	6 19	6 17	6 15	6 13	6 10
25	6 59	6 57	6 55	6 53	6 51	6 49	6 46	6 43	6 40	6 37	6 33	6 29	6 24	6 19
26	7 30	7 27	7 25	7 22	7 18	7 15	7 11	7 07	7 02	6 57	6 51	6 45	6 37	6 29
27	8 04	8 00	7 56	7 53	7 48	7 44	7 39	7 33	7 27	7 20	7 12	7 03	6 53	6 41
28	8 40	8 36	8 32	8 27	8 22	8 16	8 10	8 03	7 56	7 47	7 38	7 26	7 13	6 58
29	9 21	9 16	9 11	9 06	9 00	8 54	8 47	8 39	8 30	8 20	8 09	7 56	7 40	7 21
30	10 06	10 01	9 56	9 50	9 44	9 37	9 29	9 21	9 12	9 01	8 49	8 35	8 17	7 56
31	10 57	10 52	10 46	10 40	10 34	10 27	10 20	10 11	10 02	9 51	9 39	9 24	9 07	8 45
Apr. 1	11 52	11 47	11 42	11 37	11 31	11 25	11 18	11 10	11 01	10 51	10 39	10 26	10 10	9 50
2	12 53	12 49	12 44	12 40	12 34	12 29	12 23	12 16	12 08	12 00	11 50	11 39	11 26	11 09

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 1	23 40	23 58	.. ..	.. ..	.. ..	.. ..	0 02	0 16	0 29	0 43	0 57	1 13	1 23	1 34
2	.. ..	.. ..	0 12	0 23	0 33	0 42	0 57	1 10	1 22	1 34	1 47	2 02	2 10	2 20
3	0 51	1 05	1 17	1 26	1 34	1 42	1 54	2 05	2 15	2 25	2 36	2 48	2 55	3 03
4	2 07	2 18	2 26	2 33	2 39	2 44	2 53	3 01	3 09	3 16	3 24	3 33	3 38	3 44
5	3 28	3 34	3 39	3 43	3 46	3 49	3 54	3 59	4 03	4 07	4 12	4 17	4 20	4 23
6	4 52	4 53	4 54	4 54	4 55	4 56	4 56	4 57	4 58	4 59	5 00	5 01	5 01	5 02
7	6 18	6 14	6 10	6 08	6 05	6 03	6 00	5 57	5 54	5 51	5 48	5 45	5 43	5 41
8	7 44	7 35	7 28	7 21	7 16	7 12	7 04	6 57	6 51	6 44	6 38	6 30	6 26	6 21
9	9 08	8 54	8 43	8 34	8 27	8 20	8 08	7 58	7 49	7 39	7 29	7 18	7 12	7 04
10	10 27	10 10	9 56	9 45	9 35	9 26	9 12	8 59	8 47	8 35	8 23	8 09	8 00	7 51
11	11 39	11 19	11 03	10 50	10 39	10 30	10 13	9 59	9 46	9 32	9 18	9 02	8 52	8 42
12	12 40	12 19	12 03	11 50	11 38	11 28	11 11	10 57	10 43	10 29	10 14	9 57	9 47	9 36
13	13 31	13 11	12 55	12 43	12 32	12 22	12 06	11 51	11 38	11 24	11 10	10 53	10 44	10 33
14	14 12	13 54	13 40	13 29	13 19	13 10	12 55	12 42	12 30	12 18	12 05	11 50	11 41	11 31
15	14 45	14 30	14 19	14 09	14 01	13 54	13 41	13 30	13 20	13 09	12 58	12 46	12 38	12 30
16	15 12	15 01	14 53	14 45	14 39	14 33	14 23	14 15	14 07	13 59	13 50	13 40	13 35	13 28
17	15 36	15 29	15 23	15 18	15 14	15 10	15 03	14 57	14 52	14 46	14 41	14 34	14 30	14 26
18	15 58	15 54	15 51	15 49	15 46	15 44	15 41	15 38	15 35	15 33	15 30	15 26	15 24	15 22
19	16 18	16 18	16 18	16 18	16 18	16 18	16 18	16 18	16 18	16 18	16 18	16 18	16 18	16 18
20	16 38	16 42	16 45	16 47	16 49	16 51	16 55	16 58	17 00	17 03	17 06	17 10	17 12	17 14
21	16 59	17 07	17 12	17 17	17 22	17 25	17 32	17 38	17 43	17 49	17 55	18 01	18 05	18 10
22	17 22	17 33	17 42	17 49	17 55	18 01	18 10	18 19	18 27	18 35	18 43	18 53	18 59	19 05
23	17 48	18 02	18 14	18 23	18 31	18 38	18 50	19 01	19 11	19 22	19 33	19 45	19 52	20 01
24	18 19	18 36	18 49	19 00	19 10	19 18	19 33	19 46	19 58	20 10	20 22	20 37	20 46	20 56
25	18 55	19 14	19 29	19 42	19 52	20 02	20 18	20 32	20 45	20 58	21 13	21 29	21 38	21 49

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 1	14 41	14 22	14 08	13 56	13 45	13 36	13 21	13 07	12 54	12 42	12 28	12 12	12 03	11 52	
2	15 19	15 03	14 51	14 40	14 31	14 24	14 10	13 58	13 47	13 36	13 24	13 10	13 02	12 53	
3	15 52	15 40	15 30	15 22	15 15	15 09	14 59	14 49	14 40	14 32	14 22	14 11	14 05	13 58	
4	16 21	16 14	16 07	16 02	15 58	15 53	15 46	15 40	15 34	15 28	15 22	15 15	15 11	15 06	
5	16 49	16 46	16 43	16 41	16 39	16 37	16 34	16 31	16 29	16 26	16 24	16 20	16 19	16 16	
6	17 16	17 17	17 18	17 19	17 20	17 21	17 22	17 23	17 24	17 25	17 26	17 28	17 28	17 29	
7	17 43	17 50	17 55	17 59	18 02	18 06	18 11	18 16	18 21	18 25	18 30	18 36	18 39	18 43	
8	18 14	18 25	18 33	18 40	18 47	18 52	19 02	19 10	19 18	19 26	19 35	19 44	19 50	19 56	
9	18 48	19 03	19 15	19 25	19 34	19 41	19 54	20 06	20 16	20 27	20 39	20 52	20 59	21 08	
10	19 29	19 48	20 02	20 14	20 24	20 33	20 49	21 02	21 15	21 28	21 41	21 57	22 06	22 16	
11	20 17	20 37	20 54	21 07	21 18	21 28	21 45	21 59	22 13	22 27	22 41	22 58	23 08	23 19	
12	21 12	21 33	21 49	22 03	22 14	22 24	22 41	22 55	23 09	23 23	23 38	23 55	.. ..	.. ..
13	22 13	22 33	22 48	23 01	23 11	23 20	23 36	23 50	.. ..	.. ..	.. ..	.. ..	0 04	0 15	
14	23 18	23 35	23 48	23 59	.. ..	.. ..	.. ..	.. ..	0 03	0 16	0 30	0 45	0 55	1 05	
15	.. ..	.. ..	.. ..	.. ..	0 09	0 17	0 31	0 43	0 54	1 06	1 18	1 31	1 39	1 48	
16	0 25	0 39	0 49	0 58	1 06	1 12	1 24	1 33	1 43	1 52	2 02	2 13	2 19	2 26	
17	1 32	1 42	1 50	1 56	2 01	2 06	2 15	2 22	2 29	2 36	2 43	2 51	2 56	3 01	
18	2 39	2 44	2 49	2 53	2 56	2 59	3 04	3 09	3 13	3 17	3 21	3 26	3 29	3 32	
19	3 45	3 47	3 48	3 49	3 51	3 51	3 53	3 55	3 56	3 57	3 59	4 00	4 01	4 02	
20	4 50	4 48	4 47	4 45	4 44	4 43	4 41	4 40	4 39	4 37	4 36	4 34	4 33	4 32	
21	5 55	5 49	5 45	5 41	5 38	5 35	5 30	5 25	5 21	5 17	5 12	5 07	5 04	5 01	
22	7 00	6 50	6 43	6 36	6 31	6 26	6 18	6 11	6 04	5 57	5 50	5 42	5 37	5 32	
23	8 04	7 51	7 41	7 32	7 25	7 18	7 07	6 57	6 48	6 39	6 29	6 18	6 12	6 05	
24	9 07	8 51	8 38	8 27	8 18	8 10	7 57	7 45	7 33	7 22	7 10	6 57	6 49	6 40	
25	10 07	9 48	9 34	9 22	9 11	9 02	8 47	8 33	8 20	8 08	7 54	7 39	7 30	7 19	

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 1	1 34	1 39	1 44	1 49	1 55	2 02	2 09	2 17	2 26	2 36	2 48	3 02	3 18	3 38
2	2 20	2 24	2 29	2 34	2 39	2 45	2 51	2 59	3 06	3 15	3 26	3 37	3 51	4 08
3	3 03	3 07	3 10	3 15	3 19	3 24	3 29	3 35	3 41	3 48	3 56	4 05	4 16	4 29
4	3 44	3 47	3 49	3 52	3 56	3 59	4 03	4 07	4 11	4 16	4 22	4 29	4 36	4 45
5	4 23	4 25	4 26	4 28	4 30	4 32	4 34	4 36	4 39	4 42	4 45	4 48	4 52	4 57
6	5 02	5 02	5 02	5 03	5 03	5 03	5 04	5 04	5 05	5 05	5 06	5 07	5 08	5 08
7	5 41	5 40	5 39	5 38	5 37	5 35	5 34	5 33	5 31	5 29	5 27	5 25	5 23	5 20
8	6 21	6 19	6 17	6 14	6 12	6 09	6 06	6 03	5 59	5 55	5 50	5 45	5 39	5 32
9	7 04	7 01	6 58	6 54	6 50	6 46	6 41	6 36	6 30	6 24	6 17	6 09	5 59	5 48
10	7 51	7 47	7 43	7 38	7 33	7 27	7 21	7 14	7 07	6 58	6 49	6 38	6 25	6 10
11	8 42	8 37	8 32	8 26	8 20	8 14	8 07	7 59	7 50	7 40	7 29	7 16	7 00	6 41
12	9 36	9 31	9 26	9 20	9 14	9 07	8 59	8 51	8 41	8 31	8 19	8 04	7 47	7 25
13	10 33	10 28	10 23	10 17	10 11	10 04	9 57	9 49	9 40	9 29	9 18	9 04	8 47	8 26
14	11 31	11 27	11 22	11 17	11 12	11 06	10 59	10 52	10 43	10 34	10 24	10 11	9 57	9 39
15	12 30	12 26	12 22	12 18	12 13	12 08	12 03	11 57	11 50	11 42	11 34	11 24	11 12	10 58
16	13 28	13 25	13 22	13 19	13 15	13 12	13 07	13 03	12 58	12 52	12 45	12 38	12 29	12 19
17	14 26	14 24	14 22	14 19	14 17	14 14	14 12	14 09	14 05	14 01	13 57	13 52	13 47	13 40
18	15 22	15 21	15 20	15 19	15 18	15 17	15 15	15 14	15 12	15 10	15 08	15 06	15 03	15 00
19	16 18	16 18	16 18	16 18	16 18	16 19	16 19	16 19	16 19	16 19	16 19	16 19	16 19	16 19
20	17 14	17 15	17 16	17 17	17 19	17 20	17 21	17 23	17 25	17 27	17 29	17 32	17 34	17 38
21	18 10	18 12	18 14	18 16	18 18	18 21	18 24	18 27	18 31	18 35	18 39	18 44	18 50	18 56
22	19 05	19 08	19 11	19 15	19 18	19 22	19 26	19 31	19 36	19 42	19 48	19 56	20 05	20 15
23	20 01	20 04	20 08	20 13	20 17	20 22	20 28	20 34	20 41	20 48	20 57	21 07	21 19	21 33
24	20 56	21 00	21 05	21 10	21 15	21 21	21 28	21 35	21 43	21 52	22 03	22 15	22 30	22 48
25	21 49	21 54	21 59	22 05	22 11	22 18	22 25	22 33	22 42	22 53	23 05	23 19	23 36	23 56

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 1	11 52	11 47	11 42	11 37	11 31	11 25	11 18	11 10	11 01	10 51	10 39	10 26	10 10	9 50
2	12 53	12 49	12 44	12 40	12 34	12 29	12 23	12 16	12 08	12 00	11 50	11 39	11 26	11 09
3	13 58	13 54	13 51	13 47	13 43	13 39	13 34	13 29	13 23	13 16	13 09	13 00	12 51	12 39
4	15 06	15 04	15 01	14 59	14 56	14 53	14 50	14 47	14 43	14 39	14 34	14 28	14 22	14 14
5	16 16	16 16	16 15	16 13	16 12	16 11	16 10	16 08	16 06	16 05	16 03	16 00	15 57	15 54
6	17 29	17 29	17 30	17 30	17 31	17 31	17 31	17 32	17 33	17 33	17 34	17 35	17 36	17 37
7	18 43	18 44	18 46	18 48	18 50	18 52	18 54	18 57	19 00	19 03	19 06	19 10	19 15	19 21
8	19 56	19 59	20 02	20 05	20 09	20 12	20 17	20 21	20 26	20 32	20 38	20 46	20 54	21 04
9	21 08	21 12	21 16	21 20	21 25	21 30	21 36	21 42	21 49	21 57	22 06	22 17	22 29	22 44
10	22 16	22 21	22 26	22 31	22 37	22 43	22 50	22 58	23 06	23 16	23 27	23 40	23 55	.. ..
11	23 19	23 24	23 29	23 35	23 41	23 48	23 56	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 14
12	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 04	0 13	0 24	0 36	0 50	1 08	1 29
13	0 15	0 20	0 26	0 31	0 38	0 44	0 52	1 00	1 09	1 20	1 32	1 46	2 03	2 24
14	1 05	1 10	1 14	1 20	1 25	1 32	1 39	1 46	1 55	2 04	2 15	2 28	2 43	3 01
15	1 48	1 52	1 56	2 01	2 06	2 11	2 17	2 24	2 31	2 39	2 48	2 59	3 11	3 26
16	2 26	2 30	2 33	2 37	2 41	2 45	2 50	2 55	3 00	3 07	3 14	3 22	3 31	3 42
17	3 01	3 03	3 06	3 08	3 11	3 14	3 18	3 21	3 25	3 30	3 35	3 40	3 47	3 55
18	3 32	3 34	3 35	3 37	3 39	3 40	3 42	3 45	3 47	3 50	3 53	3 56	4 00	4 04
19	4 02	4 03	4 03	4 04	4 04	4 05	4 06	4 06	4 07	4 08	4 09	4 10	4 11	4 12
20	4 32	4 31	4 31	4 30	4 29	4 29	4 28	4 27	4 26	4 25	4 24	4 23	4 22	4 20
21	5 01	5 00	4 58	4 57	4 55	4 53	4 51	4 49	4 46	4 43	4 40	4 37	4 33	4 28
22	5 32	5 30	5 27	5 24	5 21	5 18	5 15	5 11	5 07	5 03	4 57	4 52	4 45	4 37
23	6 05	6 01	5 58	5 54	5 50	5 46	5 41	5 36	5 31	5 24	5 17	5 09	4 59	4 48
24	6 40	6 36	6 32	6 27	6 22	6 17	6 11	6 05	5 58	5 50	5 41	5 30	5 18	5 03
25	7 19	7 15	7 10	7 05	6 59	6 53	6 46	6 38	6 30	6 20	6 10	5 57	5 42	5 24

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	18 19	18 36	18 49	19 00	19 10	19 18	19 33	19 46	19 58	20 10	20 22	20 37	20 46	20 56
25	18 55	19 14	19 29	19 42	19 52	20 02	20 18	20 32	20 45	20 58	21 13	21 29	21 38	21 49
26	19 38	19 58	20 14	20 28	20 39	20 49	21 05	21 20	21 34	21 48	22 03	22 20	22 30	22 41
27	20 29	20 49	21 05	21 18	21 29	21 39	21 56	22 11	22 24	22 38	22 53	23 09	23 19	23 30
28	21 28	21 47	22 01	22 14	22 24	22 33	22 49	23 02	23 15	23 28	23 42	23 57	.. ..	.. ..
29	22 34	22 50	23 03	23 13	23 22	23 30	23 44	23 55	.. ..	.. ..	.. ..	.. ..	0 06	0 16
30	23 46	23 58	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 06	0 18	0 29	0 43	0 51	0 59
May 1	.. ..	.. ..	0 08	0 16	0 23	0 29	0 40	0 49	0 58	1 07	1 16	1 27	1 33	1 40
2	1 02	1 10	1 17	1 22	1 27	1 31	1 38	1 44	1 50	1 56	2 02	2 09	2 13	2 18
3	2 22	2 26	2 29	2 31	2 33	2 35	2 38	2 40	2 43	2 46	2 48	2 51	2 53	2 55
4	3 45	3 44	3 43	3 42	3 41	3 40	3 39	3 38	3 37	3 36	3 35	3 34	3 33	3 33
5	5 10	5 04	4 58	4 54	4 50	4 47	4 42	4 37	4 32	4 28	4 23	4 18	4 15	4 11
6	6 35	6 24	6 15	6 07	6 01	5 55	5 46	5 37	5 29	5 22	5 13	5 04	4 59	4 53
7	7 59	7 43	7 31	7 20	7 11	7 04	6 51	6 39	6 28	6 18	6 06	5 53	5 46	5 38
8	9 17	8 58	8 43	8 30	8 20	8 10	7 55	7 41	7 28	7 15	7 02	6 46	6 37	6 27
9	10 26	10 05	9 49	9 35	9 24	9 14	8 57	8 42	8 28	8 14	7 59	7 42	7 32	7 21
10	11 24	11 03	10 47	10 33	10 22	10 12	9 55	9 40	9 26	9 12	8 57	8 40	8 30	8 19
11	12 10	11 51	11 36	11 24	11 13	11 04	10 48	10 35	10 22	10 09	9 55	9 39	9 30	9 19
12	12 47	12 31	12 18	12 08	11 59	11 51	11 37	11 25	11 14	11 03	10 51	10 37	10 29	10 20
13	13 17	13 05	12 55	12 46	12 39	12 33	12 22	12 12	12 03	11 54	11 44	11 33	11 27	11 20
14	13 42	13 34	13 26	13 20	13 15	13 11	13 03	12 56	12 50	12 43	12 36	12 28	12 24	12 18
15	14 04	13 59	13 55	13 52	13 49	13 46	13 42	13 38	13 34	13 30	13 26	13 21	13 19	13 16
16	14 25	14 24	14 22	14 22	14 21	14 20	14 19	14 18	14 17	14 16	14 15	14 14	14 13	14 12
17	14 45	14 47	14 49	14 51	14 52	14 53	14 55	14 57	14 59	15 01	15 03	15 05	15 06	15 08
18	15 05	15 11	15 16	15 20	15 24	15 27	15 32	15 37	15 42	15 46	15 51	15 57	16 00	16 04

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	9 07	8 51	8 38	8 27	8 18	8 10	7 57	7 45	7 33	7 22	7 10	6 57	6 49	6 40
25	10 07	9 48	9 34	9 22	9 11	9 02	8 47	8 33	8 20	8 08	7 54	7 39	7 30	7 19
26	11 04	10 43	10 27	10 14	10 03	9 54	9 37	9 22	9 09	8 55	8 40	8 24	8 14	8 03
27	11 55	11 34	11 18	11 05	10 54	10 44	10 27	10 12	9 58	9 44	9 29	9 12	9 02	8 51
28	12 40	12 20	12 05	11 52	11 42	11 32	11 16	11 02	10 49	10 35	10 21	10 05	9 55	9 44
29	13 18	13 02	12 48	12 37	12 27	12 19	12 04	11 52	11 40	11 28	11 15	11 00	10 51	10 41
30	13 52	13 38	13 28	13 18	13 11	13 04	12 52	12 41	12 31	12 21	12 10	11 58	11 51	11 43
May 1	14 22	14 12	14 04	13 58	13 52	13 47	13 38	13 30	13 23	13 16	13 08	12 59	12 53	12 47
2	14 49	14 43	14 39	14 35	14 32	14 29	14 24	14 19	14 15	14 11	14 06	14 01	13 58	13 55
3	15 15	15 14	15 13	15 12	15 12	15 11	15 10	15 09	15 08	15 08	15 07	15 06	15 05	15 04
4	15 41	15 44	15 47	15 50	15 52	15 54	15 57	16 00	16 03	16 06	16 08	16 12	16 14	16 16
5	16 09	16 17	16 24	16 30	16 35	16 39	16 46	16 53	16 59	17 05	17 12	17 19	17 24	17 29
6	16 41	16 54	17 04	17 13	17 20	17 27	17 38	17 48	17 57	18 07	18 16	18 28	18 35	18 42
7	17 18	17 35	17 49	18 00	18 09	18 18	18 32	18 45	18 57	19 09	19 21	19 36	19 44	19 54
8	18 03	18 23	18 39	18 52	19 03	19 12	19 29	19 43	19 57	20 10	20 24	20 41	20 51	21 01
9	18 57	19 18	19 34	19 48	19 59	20 09	20 27	20 42	20 56	21 10	21 25	21 42	21 52	22 03
10	19 58	20 18	20 34	20 47	20 58	21 08	21 25	21 39	21 53	22 06	22 21	22 37	22 47	22 58
11	21 04	21 22	21 36	21 48	21 58	22 07	22 22	22 35	22 47	22 59	23 12	23 27	23 35	23 45
12	22 12	22 27	22 39	22 48	22 57	23 04	23 17	23 28	23 38	23 48	23 59	.. ..	.. ..	.. ..
13	23 20	23 32	23 40	23 48	23 54	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 11	0 18	0 26
14	.. ..	.. ..	.. ..	.. ..	.. ..	0 00	0 09	0 18	0 26	0 34	0 42	0 51	0 57	1 03
15	0 28	0 35	0 41	0 46	0 50	0 54	1 00	1 06	1 11	1 16	1 22	1 28	1 31	1 35
16	1 35	1 38	1 41	1 43	1 45	1 47	1 50	1 52	1 55	1 57	2 00	2 02	2 04	2 06
17	2 40	2 40	2 39	2 39	2 39	2 39	2 38	2 38	2 37	2 37	2 36	2 36	2 35	2 35
18	3 46	3 41	3 38	3 35	3 32	3 30	3 26	3 23	3 20	3 16	3 13	3 09	3 07	3 04

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
 MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	20 56	21 00	21 05	21 10	21 15	21 21	21 28	21 35	21 43	21 52	22 03	22 15	22 30	22 48
25	21 49	21 54	21 59	22 05	22 11	22 18	22 25	22 33	22 42	22 53	23 05	23 19	23 36	23 56
26	22 41	22 46	22 52	22 58	23 04	23 11	23 19	23 27	23 37	23 47	.. ..	.. ..	.. ..	.. ..
27	23 30	23 35	23 41	23 46	23 53	23 59	.. ..	.. ..	.. ..	.. ..	0 00	0 15	0 33	0 55
28	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 07	0 15	0 25	0 35	0 47	1 02	1 19	1 40
29	0 16	0 21	0 26	0 31	0 37	0 43	0 50	0 58	1 06	1 16	1 27	1 39	1 54	2 13
30	0 59	1 03	1 08	1 12	1 17	1 22	1 28	1 34	1 42	1 50	1 59	2 09	2 21	2 36
May 1	1 40	1 43	1 46	1 50	1 53	1 57	2 02	2 07	2 12	2 18	2 25	2 33	2 42	2 52
2	2 18	2 20	2 22	2 25	2 27	2 30	2 33	2 36	2 39	2 43	2 48	2 53	2 58	3 05
3	2 55	2 56	2 57	2 58	2 59	3 01	3 02	3 03	3 05	3 07	3 08	3 11	3 13	3 16
4	3 33	3 32	3 32	3 32	3 31	3 31	3 31	3 30	3 30	3 29	3 29	3 28	3 27	3 26
5	4 11	4 10	4 08	4 07	4 05	4 03	4 01	3 58	3 56	3 53	3 50	3 46	3 42	3 37
6	4 53	4 50	4 47	4 44	4 41	4 37	4 33	4 29	4 25	4 19	4 14	4 07	3 59	3 51
7	5 38	5 34	5 30	5 26	5 21	5 16	5 11	5 05	4 58	4 51	4 42	4 33	4 22	4 08
8	6 27	6 23	6 18	6 13	6 07	6 01	5 54	5 47	5 38	5 29	5 18	5 06	4 52	4 34
9	7 21	7 16	7 11	7 05	6 59	6 52	6 45	6 36	6 27	6 16	6 04	5 50	5 33	5 12
10	8 19	8 14	8 09	8 03	7 57	7 50	7 42	7 34	7 24	7 13	7 01	6 46	6 29	6 07
11	9 19	9 14	9 09	9 04	8 58	8 52	8 45	8 37	8 28	8 18	8 07	7 53	7 37	7 18
12	10 20	10 16	10 11	10 07	10 01	9 56	9 50	9 43	9 36	9 27	9 18	9 07	8 53	8 38
13	11 20	11 16	11 13	11 09	11 05	11 01	10 56	10 51	10 45	10 38	10 31	10 22	10 12	10 01
14	12 18	12 16	12 14	12 11	12 08	12 05	12 02	11 58	11 54	11 49	11 44	11 38	11 31	11 23
15	13 16	13 14	13 13	13 12	13 10	13 08	13 06	13 04	13 02	12 59	12 56	12 53	12 49	12 45
16	14 12	14 12	14 11	14 11	14 11	14 10	14 10	14 09	14 09	14 08	14 07	14 07	14 06	14 05
17	15 08	15 09	15 09	15 10	15 11	15 12	15 13	15 14	15 15	15 16	15 18	15 19	15 21	15 23
18	16 04	16 05	16 07	16 09	16 11	16 13	16 15	16 18	16 21	16 24	16 28	16 32	16 37	16 42

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	6 40	6 36	6 32	6 27	6 22	6 17	6 11	6 05	5 58	5 50	5 41	5 30	5 18	5 03
25	7 19	7 15	7 10	7 05	6 59	6 53	6 46	6 38	6 30	6 20	6 10	5 57	5 42	5 24
26	8 03	7 58	7 53	7 47	7 41	7 34	7 26	7 18	7 09	6 58	6 46	6 32	6 15	5 54
27	8 51	8 46	8 41	8 35	8 28	8 21	8 14	8 05	7 56	7 45	7 32	7 17	6 59	6 37
28	9 44	9 39	9 34	9 28	9 22	9 15	9 08	9 00	8 51	8 40	8 28	8 14	7 57	7 36
29	10 41	10 37	10 32	10 27	10 22	10 16	10 09	10 02	9 54	9 44	9 34	9 22	9 07	8 49
30	11 43	11 39	11 35	11 31	11 27	11 22	11 16	11 10	11 04	10 56	10 48	10 38	10 26	10 13
May 1	12 47	12 45	12 42	12 39	12 35	12 32	12 28	12 24	12 19	12 13	12 07	12 00	11 52	11 43
2	13 55	13 53	13 51	13 50	13 48	13 46	13 43	13 41	13 38	13 35	13 32	13 28	13 23	13 18
3	15 04	15 04	15 03	15 03	15 03	15 02	15 02	15 01	15 01	15 00	14 59	14 58	14 57	14 56
4	16 16	16 17	16 18	16 19	16 20	16 21	16 23	16 24	16 26	16 27	16 29	16 32	16 34	16 38
5	17 29	17 31	17 33	17 36	17 38	17 41	17 45	17 48	17 52	17 56	18 01	18 07	18 13	18 21
6	18 42	18 45	18 49	18 53	18 57	19 01	19 06	19 12	19 18	19 25	19 32	19 41	19 52	20 04
7	19 54	19 58	20 03	20 08	20 13	20 19	20 25	20 32	20 40	20 49	20 59	21 11	21 25	21 42
8	21 01	21 06	21 12	21 17	21 23	21 30	21 37	21 46	21 55	22 05	22 17	22 31	22 48	23 09
9	22 03	22 08	22 14	22 20	22 26	22 33	22 40	22 49	22 58	23 09	23 22	23 36	23 54	.. ..
10	22 58	23 03	23 08	23 13	23 19	23 26	23 33	23 41	23 50	.. ..	.. ..	.. ..	.. ..	0 16
11	23 45	23 49	23 54	23 59	.. ..	.. ..	.. ..	.. ..	.. ..	0 00	0 12	0 26	0 42	1 02
12	.. ..	.. ..	.. ..	.. ..	0 04	0 10	0 17	0 24	0 31	0 40	0 50	1 02	1 16	1 32
13	0 26	0 30	0 34	0 38	0 42	0 47	0 52	0 58	1 04	1 11	1 19	1 28	1 39	1 52
14	1 03	1 05	1 08	1 11	1 15	1 18	1 22	1 26	1 31	1 36	1 42	1 49	1 56	2 05
15	1 35	1 37	1 39	1 41	1 43	1 45	1 48	1 51	1 54	1 57	2 01	2 05	2 10	2 16
16	2 06	2 07	2 07	2 08	2 09	2 10	2 12	2 13	2 14	2 16	2 17	2 19	2 21	2 24
17	2 35	2 35	2 35	2 35	2 34	2 34	2 34	2 34	2 33	2 33	2 33	2 32	2 32	2 31
18	3 04	3 03	3 02	3 01	2 59	2 58	2 56	2 55	2 53	2 51	2 48	2 45	2 42	2 39

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	14 45	14 47	14 49	14 51	14 52	14 53	14 55	14 57	14 59	15 01	15 03	15 05	15 06	15 08
18	15 05	15 11	15 16	15 20	15 24	15 27	15 32	15 37	15 42	15 46	15 51	15 57	16 00	16 04
19	15 27	15 37	15 44	15 51	15 56	16 01	16 10	16 18	16 25	16 32	16 40	16 48	16 53	16 59
20	15 52	16 05	16 15	16 24	16 31	16 38	16 49	16 59	17 09	17 19	17 29	17 40	17 47	17 55
21	16 20	16 36	16 49	17 00	17 09	17 17	17 31	17 43	17 55	18 06	18 19	18 33	18 41	18 51
22	16 54	17 13	17 28	17 40	17 51	18 00	18 15	18 29	18 42	18 55	19 09	19 25	19 35	19 45
23	17 35	17 56	18 12	18 25	18 36	18 46	19 03	19 17	19 31	19 45	20 00	20 17	20 27	20 38
24	18 24	18 44	19 01	19 14	19 25	19 35	19 52	20 07	20 21	20 35	20 50	21 07	21 17	21 29
25	19 20	19 40	19 55	20 08	20 19	20 28	20 45	20 59	21 12	21 25	21 40	21 56	22 05	22 16
26	20 24	20 41	20 55	21 06	21 16	21 24	21 39	21 51	22 03	22 15	22 28	22 42	22 50	23 00
27	21 33	21 47	21 58	22 07	22 15	22 22	22 34	22 44	22 54	23 04	23 14	23 26	23 33	23 40
28	22 46	22 56	23 04	23 11	23 17	23 21	23 30	23 38	23 45	23 52	23 59	.. ..	.. ..	.. ..
29	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 08	0 13	0 18
30	0 03	0 08	0 13	0 17	0 20	0 22	0 27	0 32	0 36	0 40	0 44	0 49	0 51	0 55
31	1 22	1 23	1 23	1 24	1 25	1 25	1 26	1 26	1 27	1 28	1 28	1 29	1 30	1 30
June 1	2 43	2 39	2 36	2 33	2 31	2 29	2 26	2 22	2 20	2 17	2 14	2 11	2 09	2 07
2	4 06	3 57	3 50	3 44	3 39	3 35	3 27	3 20	3 14	3 08	3 01	2 54	2 50	2 45
3	5 29	5 16	5 05	4 56	4 48	4 42	4 30	4 20	4 11	4 01	3 52	3 40	3 34	3 27
4	6 50	6 32	6 18	6 07	5 57	5 49	5 34	5 21	5 09	4 57	4 45	4 31	4 22	4 13
5	8 04	7 44	7 28	7 15	7 04	6 54	6 37	6 23	6 09	5 56	5 41	5 25	5 15	5 05
6	9 09	8 48	8 31	8 17	8 06	7 56	7 38	7 23	7 09	6 55	6 40	6 22	6 12	6 01
7	10 02	9 42	9 26	9 13	9 02	8 52	8 35	8 21	8 07	7 53	7 39	7 22	7 12	7 01
8	10 45	10 27	10 13	10 02	9 52	9 43	9 28	9 15	9 03	8 50	8 37	8 22	8 13	8 03
9	11 19	11 05	10 53	10 44	10 35	10 28	10 16	10 05	9 55	9 44	9 34	9 21	9 14	9 05
10	11 47	11 36	11 28	11 20	11 14	11 09	11 00	10 51	10 44	10 36	10 28	10 18	10 13	10 06

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	2 40	2 40	2 39	2 39	2 39	2 39	2 38	2 38	2 37	2 37	2 36	2 36	2 35	2 35
18	3 46	3 41	3 38	3 35	3 32	3 30	3 26	3 23	3 20	3 16	3 13	3 09	3 07	3 04
19	4 51	4 42	4 36	4 30	4 26	4 22	4 14	4 08	4 02	3 56	3 50	3 43	3 39	3 34
20	5 55	5 43	5 34	5 26	5 19	5 13	5 03	4 54	4 46	4 38	4 29	4 18	4 13	4 06
21	6 59	6 44	6 32	6 22	6 13	6 06	5 53	5 41	5 31	5 20	5 09	4 56	4 49	4 40
22	8 01	7 43	7 29	7 17	7 07	6 58	6 43	6 30	6 18	6 05	5 52	5 37	5 28	5 18
23	9 00	8 40	8 24	8 11	8 00	7 50	7 34	7 19	7 06	6 52	6 38	6 21	6 12	6 01
24	9 53	9 32	9 16	9 03	8 51	8 41	8 24	8 09	7 55	7 41	7 26	7 09	6 59	6 48
25	10 41	10 21	10 05	9 52	9 41	9 31	9 14	9 00	8 46	8 32	8 17	8 00	7 51	7 39
26	11 21	11 03	10 49	10 37	10 27	10 18	10 03	9 49	9 37	9 24	9 10	8 55	8 46	8 35
27	11 56	11 41	11 29	11 19	11 11	11 03	10 50	10 38	10 28	10 17	10 05	9 52	9 44	9 35
28	12 26	12 15	12 06	11 58	11 52	11 46	11 36	11 27	11 18	11 10	11 01	10 50	10 44	10 37
29	12 53	12 46	12 40	12 35	12 31	12 27	12 20	12 15	12 09	12 03	11 57	11 50	11 46	11 42
30	13 18	13 15	13 13	13 11	13 09	13 08	13 05	13 02	13 00	12 58	12 55	12 52	12 50	12 48
31	13 43	13 44	13 46	13 47	13 48	13 48	13 50	13 51	13 52	13 53	13 54	13 55	13 56	13 57
June 1	14 09	14 15	14 20	14 24	14 27	14 30	14 36	14 41	14 45	14 50	14 55	15 00	15 03	15 07
2	14 37	14 48	14 56	15 04	15 10	15 15	15 25	15 33	15 41	15 48	15 57	16 06	16 12	16 18
3	15 11	15 26	15 37	15 47	15 56	16 03	16 16	16 28	16 38	16 49	17 00	17 13	17 21	17 30
4	15 51	16 09	16 24	16 36	16 47	16 56	17 11	17 25	17 38	17 50	18 04	18 20	18 29	18 39
5	16 40	17 01	17 17	17 30	17 42	17 52	18 09	18 24	18 38	18 52	19 07	19 24	19 34	19 45
6	17 37	17 59	18 15	18 29	18 40	18 51	19 08	19 23	19 37	19 51	20 06	20 23	20 33	20 44
7	18 43	19 02	19 18	19 30	19 41	19 51	20 07	20 21	20 34	20 47	21 01	21 17	21 26	21 37
8	19 52	20 09	20 22	20 33	20 42	20 50	21 04	21 17	21 28	21 39	21 51	22 05	22 13	22 22
9	21 03	21 16	21 26	21 35	21 42	21 49	22 00	22 09	22 19	22 28	22 37	22 48	22 54	23 01
10	22 12	22 22	22 29	22 35	22 40	22 45	22 53	23 00	23 06	23 12	23 19	23 27	23 31	23 36

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	15 08	15 09	15 09	15 10	15 11	15 12	15 13	15 14	15 15	15 16	15 18	15 19	15 21	15 23
18	16 04	16 05	16 07	16 09	16 11	16 13	16 15	16 18	16 21	16 24	16 28	16 32	16 37	16 42
19	16 59	17 02	17 05	17 08	17 11	17 14	17 18	17 22	17 27	17 32	17 38	17 44	17 52	18 01
20	17 55	17 58	18 02	18 06	18 10	18 15	18 20	18 26	18 32	18 39	18 47	18 56	19 07	19 20
21	18 51	18 55	18 59	19 04	19 09	19 15	19 21	19 28	19 36	19 45	19 55	20 06	20 20	20 37
22	19 45	19 50	19 55	20 01	20 07	20 13	20 20	20 28	20 37	20 47	20 59	21 13	21 29	21 49
23	20 38	20 43	20 49	20 55	21 01	21 08	21 16	21 24	21 34	21 45	21 57	22 12	22 30	22 53
24	21 29	21 34	21 39	21 45	21 52	21 59	22 06	22 15	22 25	22 35	22 48	23 03	23 21	23 43
25	22 16	22 21	22 26	22 32	22 38	22 44	22 51	22 59	23 08	23 18	23 30	23 44	.. ..	.. ..
26	23 00	23 04	23 09	23 14	23 19	23 25	23 31	23 38	23 45	23 54	.. ..	.. ..	0 00	0 19
27	23 40	23 44	23 48	23 51	23 56	.. ..	.. ..	.. ..	.. ..	.. ..	0 04	0 15	0 29	0 45
28	.. ..	.. ..	.. ..	.. ..	.. ..	0 00	0 05	0 11	0 17	0 24	0 31	0 40	0 50	1 02
29	0 18	0 21	0 23	0 26	0 29	0 33	0 36	0 40	0 44	0 49	0 54	1 01	1 08	1 16
30	0 55	0 56	0 57	0 59	1 01	1 03	1 05	1 07	1 09	1 12	1 15	1 18	1 22	1 26
31	1 30	1 31	1 31	1 31	1 31	1 32	1 32	1 33	1 33	1 33	1 34	1 35	1 35	1 36
June 1	2 07	2 06	2 05	2 04	2 03	2 01	2 00	1 59	1 57	1 55	1 53	1 51	1 49	1 46
2	2 45	2 43	2 41	2 38	2 36	2 33	2 30	2 27	2 23	2 19	2 15	2 10	2 04	1 57
3	3 27	3 24	3 20	3 17	3 13	3 08	3 04	2 59	2 53	2 47	2 40	2 32	2 22	2 11
4	4 13	4 09	4 04	4 00	3 55	3 49	3 43	3 36	3 29	3 20	3 11	3 00	2 47	2 31
5	5 05	5 00	4 55	4 49	4 43	4 36	4 29	4 21	4 12	4 02	3 51	3 37	3 21	3 02
6	6 01	5 56	5 50	5 45	5 38	5 31	5 23	5 15	5 05	4 54	4 42	4 27	4 09	3 47
7	7 01	6 56	6 51	6 45	6 39	6 32	6 25	6 16	6 07	5 56	5 44	5 30	5 13	4 51
8	8 03	7 59	7 54	7 49	7 43	7 37	7 31	7 23	7 15	7 06	6 55	6 42	6 28	6 10
9	9 05	9 02	8 58	8 54	8 49	8 44	8 39	8 33	8 26	8 18	8 10	8 00	7 48	7 34
10	10 06	10 04	10 01	9 57	9 54	9 50	9 46	9 42	9 37	9 31	9 25	9 18	9 10	9 00

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	2 35	2 35	2 35	2 35	2 34	2 34	2 34	2 34	2 33	2 33	2 33	2 32	2 32	2 31
18	3 04	3 03	3 02	3 01	2 59	2 58	2 56	2 55	2 53	2 51	2 48	2 45	2 42	2 39
19	3 34	3 32	3 30	3 28	3 25	3 23	3 20	3 16	3 13	3 09	3 04	3 00	2 54	2 47
20	4 06	4 03	4 00	3 57	3 53	3 49	3 45	3 40	3 35	3 29	3 23	3 15	3 07	2 57
21	4 40	4 37	4 33	4 28	4 24	4 19	4 13	4 07	4 01	3 53	3 45	3 35	3 23	3 10
22	5 18	5 14	5 09	5 04	4 59	4 53	4 46	4 39	4 31	4 22	4 11	3 59	3 45	3 28
23	6 01	5 56	5 51	5 45	5 39	5 32	5 25	5 17	5 07	4 57	4 45	4 31	4 15	3 54
24	6 48	6 42	6 37	6 31	6 25	6 18	6 10	6 01	5 52	5 41	5 28	5 13	4 55	4 32
25	7 39	7 34	7 29	7 23	7 17	7 10	7 02	6 54	6 44	6 33	6 21	6 06	5 48	5 26
26	8 35	8 31	8 26	8 20	8 14	8 08	8 01	7 53	7 45	7 35	7 24	7 10	6 54	6 35
27	9 35	9 31	9 27	9 22	9 17	9 12	9 06	8 59	8 52	8 44	8 34	8 23	8 11	7 55
28	10 37	10 34	10 31	10 27	10 24	10 19	10 15	10 10	10 04	9 58	9 51	9 43	9 34	9 22
29	11 42	11 40	11 38	11 35	11 33	11 30	11 27	11 24	11 20	11 15	11 12	11 07	11 01	10 54
30	12 48	12 48	12 47	12 46	12 45	12 43	12 42	12 41	12 39	12 38	12 36	12 33	12 31	12 28
31	13 57	13 57	13 57	13 58	13 58	13 59	13 59	14 00	14 00	14 01	14 02	14 03	14 04	14 05
June 1	15 07	15 08	15 10	15 12	15 14	15 16	15 18	15 21	15 24	15 27	15 30	15 34	15 39	15 44
2	16 18	16 21	16 24	16 27	16 30	16 34	16 38	16 43	16 48	16 53	17 00	17 07	17 15	17 25
3	17 30	17 33	17 37	17 42	17 47	17 52	17 58	18 04	18 11	18 19	18 28	18 38	18 50	19 05
4	18 39	18 44	18 49	18 54	19 00	19 06	19 13	19 21	19 30	19 39	19 51	20 04	20 20	20 39
5	19 45	19 50	19 55	20 01	20 08	20 15	20 22	20 31	20 40	20 51	21 03	21 18	21 36	21 58
6	20 44	20 49	20 55	21 01	21 07	21 14	21 21	21 30	21 39	21 50	22 02	22 17	22 34	22 56
7	21 37	21 41	21 46	21 52	21 57	22 04	22 11	22 18	22 27	22 37	22 48	23 01	23 16	23 34
8	22 22	22 26	22 30	22 35	22 40	22 45	22 51	22 57	23 04	23 12	23 22	23 32	23 44	23 59
9	23 01	23 04	23 08	23 11	23 15	23 19	23 24	23 29	23 34	23 41	23 47	23 55	.. ..	.. ..
10	23 36	23 38	23 41	23 43	23 46	23 49	23 52	23 55	23 59	.. ..	.. ..	.. ..	0 04	0 15

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	10 45	10 27	10 13	10 02	9 52	9 43	9 28	9 15	9 03	8 50	8 37	8 22	8 13	8 03
9	11 19	11 05	10 53	10 44	10 35	10 28	10 16	10 05	9 55	9 44	9 34	9 21	9 14	9 05
10	11 47	11 36	11 28	11 20	11 14	11 09	11 00	10 51	10 44	10 36	10 28	10 18	10 13	10 06
11	12 10	12 04	11 58	11 54	11 50	11 46	11 40	11 35	11 30	11 25	11 19	11 13	11 10	11 06
12	12 32	12 29	12 26	12 24	12 22	12 21	12 18	12 16	12 14	12 12	12 09	12 07	12 05	12 03
13	12 52	12 52	12 53	12 54	12 54	12 54	12 55	12 56	12 57	12 57	12 58	12 59	12 59	13 00
14	13 12	13 16	13 20	13 23	13 25	13 28	13 32	13 36	13 39	13 42	13 46	13 50	13 53	13 56
15	13 33	13 41	13 47	13 53	13 58	14 02	14 09	14 16	14 22	14 28	14 34	14 42	14 46	14 51
16	13 56	14 08	14 17	14 25	14 32	14 37	14 48	14 57	15 06	15 14	15 23	15 34	15 40	15 47
17	14 23	14 38	14 50	14 59	15 08	15 16	15 29	15 40	15 51	16 02	16 13	16 26	16 34	16 43
18	14 54	15 12	15 26	15 38	15 48	15 57	16 12	16 25	16 38	16 50	17 04	17 19	17 28	17 38
19	15 32	15 52	16 08	16 21	16 32	16 42	16 58	17 13	17 27	17 40	17 55	18 12	18 22	18 33
20	16 18	16 39	16 56	17 09	17 21	17 31	17 48	18 03	18 17	18 31	18 46	19 03	19 14	19 25
21	17 13	17 33	17 49	18 02	18 13	18 23	18 40	18 55	19 08	19 22	19 37	19 53	20 03	20 14
22	18 15	18 33	18 48	19 00	19 10	19 19	19 34	19 47	20 00	20 13	20 26	20 41	20 50	21 00
23	19 23	19 38	19 50	20 01	20 09	20 17	20 30	20 41	20 52	21 02	21 13	21 26	21 34	21 42
24	20 36	20 47	20 56	21 04	21 10	21 16	21 26	21 34	21 43	21 51	21 59	22 09	22 15	22 21
25	21 51	21 58	22 04	22 09	22 13	22 16	22 22	22 28	22 33	22 38	22 44	22 50	22 53	22 58
26	23 08	23 11	23 13	23 15	23 16	23 17	23 20	23 22	23 24	23 25	23 28	23 30	23 31	23 33
27	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
28	0 27	0 25	0 23	0 22	0 20	0 19	0 18	0 16	0 14	0 13	0 12	0 10	0 09	0 08
29	1 47	1 40	1 35	1 30	1 26	1 23	1 17	1 11	1 07	1 02	0 57	0 51	0 48	0 44
30	3 07	2 56	2 47	2 39	2 33	2 27	2 17	2 08	2 00	1 52	1 44	1 34	1 29	1 23
July 1	4 27	4 11	3 59	3 48	3 40	3 32	3 19	3 07	2 56	2 46	2 34	2 21	2 14	2 05
2	5 43	5 24	5 09	4 56	4 46	4 36	4 21	4 07	3 54	3 41	3 28	3 12	3 03	2 53

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	19 52	20 09	20 22	20 33	20 42	20 50	21 04	21 17	21 28	21 39	21 51	22 05	22 13	22 22
9	21 03	21 16	21 26	21 35	21 42	21 49	22 00	22 09	22 19	22 28	22 37	22 48	22 54	23 01
10	22 12	22 22	22 29	22 35	22 40	22 45	22 53	23 00	23 06	23 12	23 19	23 27	23 31	23 36
11	23 21	23 26	23 30	23 34	23 36	23 39	23 44	23 47	23 51	23 55	23 58	.. ..	.. ..	.. ..
12	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 03	0 05	0 08
13	0 28	0 29	0 30	0 31	0 31	0 32	0 33	0 34	0 34	0 35	0 36	0 37	0 37	0 38
14	1 34	1 31	1 29	1 27	1 25	1 24	1 21	1 19	1 17	1 15	1 13	1 10	1 09	1 07
15	2 39	2 32	2 27	2 23	2 19	2 15	2 09	2 04	2 00	1 55	1 50	1 44	1 40	1 37
16	3 44	3 33	3 25	3 18	3 12	3 07	2 58	2 50	2 43	2 35	2 27	2 19	2 13	2 08
17	4 48	4 34	4 23	4 14	4 06	3 59	3 47	3 37	3 27	3 17	3 07	2 55	2 48	2 41
18	5 51	5 34	5 21	5 10	5 00	4 52	4 37	4 25	4 13	4 02	3 49	3 35	3 27	3 17
19	6 52	6 33	6 17	6 05	5 54	5 45	5 28	5 14	5 01	4 48	4 34	4 18	4 08	3 58
20	7 49	7 28	7 11	6 58	6 47	6 37	6 20	6 05	5 51	5 37	5 22	5 05	4 55	4 43
21	8 39	8 18	8 02	7 49	7 38	7 28	7 11	6 56	6 42	6 28	6 13	5 55	5 45	5 34
22	9 23	9 04	8 49	8 36	8 26	8 16	8 00	7 46	7 33	7 20	7 06	6 49	6 40	6 29
23	10 00	9 44	9 31	9 20	9 11	9 03	8 49	8 36	8 25	8 13	8 01	7 46	7 38	7 28
24	10 32	10 19	10 09	10 00	9 53	9 47	9 35	9 25	9 16	9 07	8 56	8 45	8 38	8 30
25	11 00	10 51	10 44	10 38	10 33	10 28	10 20	10 13	10 07	10 00	9 53	9 45	9 40	9 34
26	11 25	11 20	11 17	11 14	11 11	11 09	11 04	11 01	10 57	10 54	10 50	10 45	10 43	10 40
27	11 49	11 49	11 49	11 49	11 48	11 48	11 48	11 48	11 48	11 47	11 47	11 47	11 47	11 46
28	12 14	12 18	12 21	12 24	12 27	12 29	12 33	12 36	12 39	12 42	12 46	12 49	12 52	12 54
29	12 40	12 48	12 55	13 01	13 06	13 11	13 19	13 25	13 32	13 38	13 45	13 53	13 58	14 03
30	13 10	13 23	13 33	13 42	13 49	13 56	14 07	14 17	14 27	14 36	14 46	14 58	15 04	15 12
July 1	13 45	14 02	14 16	14 27	14 36	14 45	14 59	15 12	15 23	15 35	15 48	16 03	16 11	16 21
2	14 28	14 48	15 04	15 17	15 28	15 37	15 54	16 08	16 22	16 35	16 50	17 06	17 16	17 27

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	8 03	7 59	7 54	7 49	7 43	7 37	7 31	7 23	7 15	7 06	6 55	6 42	6 28	6 10
9	9 05	9 02	8 58	8 54	8 49	8 44	8 39	8 33	8 26	8 18	8 10	8 00	7 48	7 34
10	10 06	10 04	10 01	9 57	9 54	9 50	9 46	9 42	9 37	9 31	9 25	9 18	9 10	9 00
11	11 06	11 04	11 02	11 00	10 58	10 55	10 53	10 50	10 47	10 43	10 39	10 35	10 30	10 24
12	12 03	12 03	12 02	12 01	12 00	11 59	11 58	11 57	11 55	11 54	11 52	11 50	11 48	11 46
13	13 00	13 00	13 00	13 01	13 01	13 01	13 02	13 02	13 02	13 03	13 04	13 04	13 05	13 06
14	13 56	13 57	13 58	14 00	14 01	14 03	14 05	14 07	14 09	14 11	14 14	14 17	14 21	14 25
15	14 51	14 54	14 56	14 58	15 01	15 04	15 07	15 11	15 15	15 19	15 24	15 30	15 36	15 44
16	15 47	15 50	15 54	15 57	16 01	16 05	16 10	16 15	16 20	16 27	16 34	16 42	16 52	17 03
17	16 43	16 47	16 51	16 56	17 00	17 06	17 12	17 18	17 25	17 33	17 43	17 53	18 06	18 21
18	17 38	17 43	17 48	17 53	17 59	18 05	18 12	18 20	18 28	18 38	18 49	19 02	19 18	19 37
19	18 33	18 38	18 43	18 49	18 55	19 02	19 10	19 18	19 28	19 38	19 51	20 05	20 23	20 45
20	19 25	19 30	19 36	19 42	19 48	19 55	20 03	20 12	20 22	20 33	20 45	21 01	21 19	21 42
21	20 14	20 19	20 25	20 30	20 37	20 43	20 51	20 59	21 09	21 19	21 31	21 45	22 03	22 24
22	21 00	21 05	21 09	21 15	21 20	21 26	21 33	21 40	21 48	21 58	22 08	22 21	22 35	22 53
23	21 42	21 46	21 50	21 54	21 59	22 04	22 09	22 15	22 22	22 30	22 38	22 48	22 59	23 13
24	22 21	22 24	22 27	22 30	22 34	22 37	22 41	22 46	22 51	22 56	23 03	23 10	23 18	23 27
25	22 58	22 59	23 01	23 03	23 05	23 08	23 10	23 13	23 16	23 20	23 23	23 28	23 33	23 38
26	23 33	23 33	23 34	23 35	23 36	23 37	23 38	23 39	23 40	23 41	23 43	23 44	23 46	23 48
27	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 59	23 57
28	0 08	0 07	0 07	0 06	0 06	0 05	0 04	0 04	0 03	0 02	0 01	0 00	.. ..	.. ..
29	0 44	0 42	0 41	0 39	0 37	0 35	0 32	0 30	0 27	0 24	0 21	0 17	0 12	0 07
30	1 23	1 20	1 17	1 14	1 11	1 07	1 03	0 59	0 54	0 49	0 43	0 36	0 28	0 19
July 1	2 05	2 02	1 58	1 53	1 49	1 44	1 38	1 32	1 26	1 18	1 10	1 00	0 49	0 36
2	2 53	2 48	2 44	2 38	2 33	2 27	2 20	2 12	2 04	1 55	1 44	1 32	1 17	0 59

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	22 22	22 26	22 30	22 35	22 40	22 45	22 51	22 57	23 04	23 12	23 22	23 32	23 44	23 59
9	23 01	23 04	23 08	23 11	23 15	23 19	23 24	23 29	23 34	23 41	23 47	23 55	.. ..	.. ..
10	23 36	23 38	23 41	23 43	23 46	23 49	23 52	23 55	23 59	.. ..	.. ..	.. ..	0 04	0 15
11	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 03	0 08	0 13	0 20	0 27
12	0 08	0 09	0 11	0 12	0 13	0 15	0 17	0 19	0 21	0 23	0 26	0 29	0 32	0 36
13	0 38	0 38	0 38	0 39	0 39	0 39	0 40	0 40	0 40	0 41	0 41	0 42	0 43	0 43
14	1 07	1 06	1 06	1 05	1 04	1 03	1 02	1 01	1 00	0 58	0 57	0 55	0 53	0 51
15	1 37	1 35	1 33	1 31	1 29	1 27	1 25	1 22	1 19	1 16	1 12	1 08	1 04	0 58
16	2 08	2 05	2 02	1 59	1 56	1 53	1 49	1 45	1 40	1 35	1 30	1 23	1 16	1 07
17	2 41	2 37	2 34	2 30	2 25	2 21	2 16	2 10	2 04	1 57	1 50	1 41	1 31	1 19
18	3 17	3 13	3 09	3 04	2 59	2 53	2 47	2 40	2 32	2 24	2 14	2 03	1 50	1 34
19	3 58	3 53	3 48	3 42	3 37	3 30	3 23	3 15	3 06	2 56	2 45	2 32	2 16	1 56
20	4 43	4 38	4 33	4 27	4 20	4 13	4 06	3 57	3 48	3 37	3 24	3 09	2 52	2 29
21	5 34	5 29	5 23	5 17	5 11	5 04	4 56	4 47	4 38	4 27	4 14	3 59	3 41	3 18
22	6 29	6 24	6 19	6 13	6 07	6 01	5 53	5 45	5 36	5 26	5 14	5 00	4 43	4 22
23	7 28	7 24	7 20	7 15	7 09	7 03	6 57	6 50	6 42	6 33	6 23	6 11	5 57	5 40
24	8 30	8 27	8 23	8 19	8 15	8 11	8 05	8 00	7 54	7 47	7 39	7 30	7 19	7 06
25	9 34	9 32	9 29	9 27	9 24	9 20	9 17	9 13	9 09	9 04	8 58	8 52	8 45	8 37
26	10 40	10 39	10 37	10 36	10 34	10 32	10 31	10 28	10 26	10 24	10 21	10 17	10 14	10 09
27	11 46	11 46	11 46	11 46	11 46	11 46	11 46	11 45	11 45	11 45	11 45	11 44	11 44	11 44
28	12 54	12 55	12 56	12 58	12 59	13 00	13 02	13 04	13 06	13 08	13 10	13 13	13 16	13 20
29	14 03	14 05	14 07	14 10	14 13	14 16	14 19	14 23	14 27	14 31	14 36	14 42	14 49	14 57
30	15 12	15 15	15 19	15 23	15 27	15 32	15 36	15 42	15 48	15 55	16 03	16 12	16 22	16 35
July 1	16 21	16 25	16 30	16 34	16 40	16 46	16 52	16 59	17 07	17 16	17 26	17 38	17 52	18 09
2	17 27	17 32	17 37	17 43	17 49	17 56	18 03	18 11	18 20	18 31	18 43	18 57	19 14	19 35

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.		-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July	1	4 27	4 11	3 59	3 48	3 40	3 32	3 19	3 07	2 56	2 46	2 34	2 21	2 14	2 05
	2	5 43	5 24	5 09	4 56	4 46	4 36	4 21	4 07	3 54	3 41	3 28	3 12	3 03	2 53
	3	6 52	6 31	6 14	6 00	5 49	5 39	5 22	5 07	4 53	4 39	4 24	4 07	3 57	3 46
	4	7 50	7 29	7 13	6 59	6 48	6 38	6 20	6 05	5 51	5 37	5 22	5 05	4 55	4 44
	5	8 38	8 19	8 04	7 52	7 41	7 32	7 16	7 02	6 48	6 35	6 21	6 05	5 56	5 45
	6	9 17	9 01	8 48	8 37	8 28	8 20	8 06	7 54	7 43	7 31	7 19	7 05	6 57	6 48
	7	9 48	9 36	9 26	9 17	9 10	9 04	8 53	8 43	8 34	8 25	8 15	8 04	7 58	7 50
	8	10 14	10 05	9 58	9 53	9 48	9 43	9 35	9 29	9 22	9 16	9 09	9 01	8 57	8 52
	9	10 37	10 32	10 28	10 25	10 22	10 20	10 15	10 11	10 08	10 04	10 01	9 56	9 54	9 51
	10	10 57	10 57	10 56	10 55	10 55	10 54	10 53	10 53	10 52	10 51	10 51	10 50	10 49	10 49
	11	11 18	11 20	11 23	11 25	11 26	11 28	11 30	11 33	11 35	11 37	11 39	11 42	11 44	11 46
	12	11 38	11 45	11 50	11 54	11 58	12 02	12 07	12 13	12 18	12 23	12 28	12 34	12 38	12 42
	13	12 00	12 10	12 19	12 25	12 31	12 36	12 45	12 53	13 01	13 08	13 16	13 26	13 31	13 37
	14	12 25	12 39	12 50	12 59	13 06	13 13	13 25	13 35	13 45	13 55	14 06	14 18	14 25	14 33
	15	12 55	13 11	13 24	13 35	13 45	13 53	14 07	14 20	14 31	14 43	14 56	15 10	15 19	15 28
	16	13 30	13 49	14 04	14 16	14 27	14 36	14 52	15 06	15 19	15 33	15 47	16 03	16 13	16 23
	17	14 12	14 33	14 49	15 02	15 14	15 23	15 40	15 55	16 09	16 23	16 38	16 55	17 05	17 17
	18	15 03	15 24	15 40	15 54	16 05	16 15	16 32	16 47	17 01	17 15	17 30	17 47	17 57	18 08
	19	16 03	16 22	16 38	16 50	17 01	17 10	17 26	17 40	17 53	18 06	18 20	18 36	18 45	18 56
	20	17 10	17 27	17 40	17 51	18 00	18 08	18 22	18 34	18 46	18 57	19 09	19 23	19 31	19 40
	21	18 23	18 36	18 46	18 54	19 02	19 08	19 19	19 29	19 38	19 47	19 57	20 08	20 14	20 21
	22	19 39	19 47	19 54	20 00	20 05	20 09	20 17	20 24	20 30	20 36	20 43	20 50	20 55	20 59
	23	20 56	21 01	21 04	21 07	21 09	21 11	21 15	21 18	21 21	21 24	21 27	21 31	21 33	21 36
	24	22 15	22 15	22 14	22 14	22 14	22 13	22 13	22 13	22 12	22 12	22 12	22 11	22 11	22 11
	25	23 35	23 29	23 25	23 22	23 19	23 16	23 11	23 07	23 04	23 00	22 56	22 52	22 49	22 47

MOONSET

		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July	1	13 45	14 02	14 16	14 27	14 36	14 45	14 59	15 12	15 23	15 35	15 48	16 03	16 11	16 21
	2	14 28	14 48	15 04	15 17	15 28	15 37	15 54	16 08	16 22	16 35	16 50	17 06	17 16	17 27
	3	15 21	15 42	15 59	16 12	16 24	16 34	16 51	17 07	17 21	17 35	17 50	18 07	18 17	18 29
	4	16 22	16 43	16 59	17 12	17 24	17 33	17 50	18 05	18 19	18 33	18 47	19 04	19 14	19 25
	5	17 30	17 48	18 03	18 15	18 25	18 34	18 49	19 02	19 15	19 27	19 40	19 55	20 04	20 14
	6	18 41	18 56	19 08	19 18	19 26	19 34	19 46	19 57	20 08	20 18	20 29	20 41	20 48	20 56
	7	19 52	20 03	20 12	20 20	20 26	20 32	20 41	20 50	20 57	21 05	21 13	21 23	21 28	21 34
	8	21 03	21 10	21 16	21 20	21 24	21 28	21 34	21 39	21 44	21 49	21 55	22 01	22 04	22 08
	9	22 12	22 15	22 17	22 19	22 21	22 22	22 25	22 27	22 29	22 31	22 34	22 36	22 37	22 39
	10	23 19	23 18	23 17	23 16	23 16	23 15	23 14	23 13	23 13	23 12	23 11	23 10	23 10	23 09
	11	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 59	23 55	23 52	23 48	23 44	23 41	23 38
	12	0 25	0 20	0 16	0 13	0 10	0 07	0 03	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
	13	1 30	1 21	1 14	1 08	1 03	0 59	0 51	0 45	0 38	0 32	0 25	0 18	0 14	0 09
	14	2 35	2 22	2 12	2 04	1 57	1 51	1 40	1 31	1 22	1 13	1 04	0 54	0 47	0 41
	15	3 38	3 22	3 10	3 00	2 51	2 43	2 30	2 18	2 07	1 56	1 45	1 32	1 24	1 15
	16	4 40	4 21	4 07	3 55	3 45	3 36	3 20	3 07	2 54	2 42	2 28	2 13	2 04	1 54
	17	5 39	5 18	5 02	4 49	4 38	4 28	4 12	3 57	3 43	3 30	3 15	2 58	2 48	2 37
	18	6 32	6 11	5 55	5 42	5 30	5 20	5 03	4 48	4 34	4 20	4 05	3 47	3 37	3 26
	19	7 19	7 00	6 44	6 31	6 20	6 11	5 54	5 39	5 26	5 12	4 58	4 41	4 31	4 20
	20	8 00	7 43	7 29	7 17	7 07	6 59	6 44	6 31	6 18	6 06	5 53	5 37	5 29	5 18
	21	8 35	8 21	8 09	8 00	7 52	7 45	7 32	7 21	7 11	7 00	6 49	6 37	6 29	6 21
	22	9 05	8 54	8 46	8 39	8 33	8 28	8 19	8 11	8 03	7 55	7 47	7 37	7 32	7 25
	23	9 31	9 25	9 20	9 16	9 13	9 09	9 04	8 59	8 54	8 50	8 45	8 39	8 35	8 32
	24	9 56	9 54	9 53	9 52	9 51	9 50	9 48	9 47	9 45	9 44	9 42	9 41	9 40	9 39
	25	10 20	10 23	10 25	10 27	10 29	10 30	10 32	10 35	10 37	10 39	10 41	10 43	10 45	10 46

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

49

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
July	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1	2 05	2 02	1 58	1 53	1 49	1 44	1 38	1 32	1 26	1 18	1 10	1 00	0 49	0 36
2	2 53	2 48	2 44	2 38	2 33	2 27	2 20	2 12	2 04	1 55	1 44	1 32	1 17	0 59
3	3 46	3 41	3 35	3 30	3 23	3 17	3 09	3 01	2 51	2 41	2 28	2 14	1 57	1 36
4	4 44	4 39	4 33	4 27	4 21	4 14	4 06	3 58	3 48	3 37	3 25	3 10	2 52	2 30
5	5 45	5 40	5 35	5 30	5 24	5 17	5 10	5 02	4 53	4 43	4 31	4 18	4 01	3 41
6	6 48	6 44	6 39	6 35	6 29	6 24	6 18	6 11	6 03	5 55	5 45	5 34	5 20	5 04
7	7 50	7 47	7 44	7 40	7 36	7 31	7 27	7 21	7 16	7 09	7 02	6 53	6 43	6 31
8	8 52	8 49	8 47	8 44	8 41	8 38	8 35	8 31	8 27	8 23	8 18	8 12	8 05	7 58
9	9 51	9 50	9 48	9 47	9 45	9 44	9 42	9 40	9 38	9 35	9 33	9 30	9 26	9 22
10	10 49	10 49	10 48	10 48	10 48	10 48	10 47	10 47	10 47	10 46	10 46	10 45	10 45	10 44
11	11 46	11 46	11 47	11 48	11 49	11 50	11 51	11 53	11 54	11 56	11 57	11 59	12 02	12 04
12	12 42	12 43	12 45	12 47	12 49	12 52	12 54	12 57	13 00	13 04	13 08	13 12	13 18	13 24
13	13 37	13 40	13 43	13 46	13 49	13 53	13 57	14 01	14 06	14 12	14 18	14 25	14 33	14 43
14	14 33	14 36	14 40	14 44	14 49	14 54	14 59	15 05	15 11	15 19	15 27	15 37	15 48	16 01
15	15 28	15 33	15 37	15 42	15 48	15 54	16 00	16 07	16 15	16 24	16 34	16 46	17 01	17 18
16	16 23	16 28	16 33	16 39	16 45	16 52	16 59	17 07	17 16	17 27	17 38	17 52	18 09	18 30
17	17 17	17 22	17 28	17 33	17 40	17 47	17 55	18 03	18 13	18 24	18 37	18 52	19 10	19 33
18	18 08	18 13	18 19	18 24	18 31	18 38	18 45	18 54	19 04	19 14	19 27	19 42	19 59	20 22
19	18 56	19 01	19 06	19 11	19 17	19 24	19 31	19 38	19 47	19 57	20 08	20 21	20 37	20 56
20	19 40	19 44	19 49	19 53	19 59	20 04	20 10	20 17	20 24	20 32	20 42	20 52	21 05	21 20
21	20 21	20 25	20 28	20 32	20 35	20 40	20 44	20 49	20 55	21 01	21 09	21 17	21 26	21 37
22	20 59	21 02	21 04	21 06	21 09	21 12	21 15	21 18	21 22	21 26	21 31	21 36	21 42	21 49
23	21 36	21 37	21 38	21 39	21 40	21 42	21 43	21 45	21 47	21 49	21 51	21 54	21 56	22 00
24	22 11	22 11	22 11	22 11	22 11	22 10	22 10	22 10	22 10	22 10	22 10	22 10	22 09	22 09
25	22 47	22 45	22 44	22 43	22 41	22 40	22 38	22 36	22 34	22 31	22 29	22 26	22 23	22 19

MOONSET

July	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1	16 21	16 25	16 30	16 34	16 40	16 46	16 52	16 59	17 07	17 16	17 26	17 38	17 52	18 09	18 29
2	17 27	17 32	17 37	17 43	17 49	17 56	18 03	18 11	18 20	18 31	18 43	18 57	19 14	19 35	19 59
3	18 29	18 34	18 39	18 45	18 52	18 59	19 06	19 15	19 25	19 36	19 48	20 03	20 21	20 43	21 11
4	19 25	19 29	19 35	19 40	19 47	19 53	20 01	20 09	20 18	20 28	20 40	20 54	21 11	21 31	22 02
5	20 14	20 18	20 23	20 28	20 33	20 39	20 45	20 53	21 01	21 10	21 20	21 32	21 45	22 02	22 22
6	20 56	21 00	21 04	21 08	21 12	21 17	21 22	21 28	21 35	21 42	21 50	21 59	22 10	22 22	22 36
7	21 34	21 37	21 40	21 43	21 46	21 49	21 53	21 58	22 02	22 07	22 13	22 20	22 27	22 36	22 47
8	22 08	22 10	22 11	22 13	22 15	22 18	22 20	22 23	22 26	22 29	22 32	22 36	22 41	22 47	22 55
9	22 39	22 40	22 41	22 41	22 42	22 43	22 44	22 45	22 46	22 48	22 49	22 51	22 53	22 55	23 02
10	23 09	23 09	23 08	23 08	23 08	23 07	23 07	23 06	23 06	23 05	23 05	23 04	23 03	23 02	23 10
11	23 38	23 37	23 36	23 34	23 33	23 31	23 29	23 27	23 25	23 23	23 20	23 17	23 14	23 10	23 18
12	.. ..	.. ..	.. ..	.. ..	23 59	23 56	23 53	23 50	23 46	23 42	23 37	23 31	23 25	23 18	23 28
13	0 09	0 06	0 04	0 02	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 55	23 48	23 39	23 28
14	0 41	0 38	0 34	0 31	0 27	0 23	0 19	0 14	0 08	0 02	.. ..	.. ..	23 56	23 42	23 28
15	1 15	1 12	1 07	1 03	0 58	0 53	0 47	0 41	0 34	0 26	0 18	0 08	.. ..	.. ..	23 22
16	1 54	1 49	1 45	1 39	1 34	1 28	1 21	1 14	1 05	0 56	0 45	0 33	0 18	0 00	0 28
17	2 37	2 32	2 27	2 21	2 15	2 08	2 01	1 53	1 43	1 33	1 21	1 06	0 49	0 28	1 10
18	3 26	3 21	3 15	3 09	3 03	2 56	2 48	2 39	2 30	2 19	2 06	1 51	1 33	1 10	2 08
19	4 20	4 15	4 09	4 04	3 57	3 51	3 43	3 35	3 25	3 14	3 02	2 47	2 30	2 08	3 22
20	5 18	5 14	5 09	5 04	4 58	4 52	4 45	4 38	4 29	4 20	4 09	3 56	3 41	3 22	4 47
21	6 21	6 17	6 13	6 09	6 04	5 59	5 53	5 47	5 40	5 32	5 23	5 13	5 01	4 47	6 18
22	7 25	7 23	7 20	7 16	7 13	7 09	7 05	7 01	6 56	6 50	6 44	6 36	6 28	6 18	7 52
23	8 32	8 30	8 28	8 26	8 24	8 22	8 19	8 17	8 14	8 10	8 07	8 02	7 57	7 52	9 26
24	9 39	9 38	9 38	9 37	9 36	9 36	9 35	9 34	9 33	9 32	9 31	9 30	9 28	9 26	11 02
25	10 46	10 47	10 47	10 48	10 49	10 50	10 51	10 52	10 53	10 55	10 56	10 58	11 00	11 02	.. ..

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	22 15	22 15	22 14	22 14	22 14	22 13	22 13	22 13	22 12	22 12	22 12	22 11	22 11	22 11
25	23 35	23 29	23 25	23 22	23 19	23 16	23 11	23 07	23 04	23 00	22 56	22 52	22 49	22 47
26	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 56	23 49	23 42	23 34	23 29	23 24
27	0 54	0 44	0 36	0 30	0 24	0 19	0 11	0 03	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
28	2 12	1 58	1 47	1 38	1 30	1 23	1 10	1 00	0 50	0 41	0 30	0 19	0 12	0 04
29	3 28	3 10	2 56	2 44	2 34	2 26	2 11	1 58	1 46	1 34	1 21	1 07	0 58	0 49
30	4 38	4 17	4 01	3 48	3 37	3 27	3 11	2 56	2 43	2 29	2 15	1 58	1 49	1 38
31	5 39	5 18	5 02	4 48	4 36	4 26	4 09	3 54	3 40	3 26	3 11	2 54	2 44	2 32
Aug. 1	6 31	6 11	5 55	5 42	5 31	5 21	5 05	4 50	4 36	4 23	4 08	3 52	3 42	3 31
2	7 13	6 56	6 42	6 30	6 20	6 12	5 57	5 44	5 31	5 19	5 06	4 51	4 42	4 32
3	7 47	7 33	7 22	7 12	7 04	6 57	6 45	6 34	6 24	6 13	6 02	5 50	5 43	5 34
4	8 16	8 05	7 57	7 50	7 44	7 38	7 29	7 21	7 13	7 06	6 57	6 48	6 43	6 36
5	8 40	8 33	8 28	8 24	8 20	8 16	8 11	8 05	8 00	7 56	7 50	7 44	7 41	7 37
6	9 02	8 59	8 57	8 55	8 54	8 52	8 50	8 48	8 46	8 44	8 42	8 39	8 38	8 36
7	9 22	9 24	9 24	9 25	9 26	9 27	9 28	9 29	9 29	9 30	9 31	9 32	9 33	9 34
8	9 43	9 48	9 52	9 55	9 58	10 00	10 05	10 09	10 13	10 16	10 20	10 25	10 28	10 31
9	10 04	10 13	10 20	10 26	10 30	10 35	10 42	10 49	10 56	11 02	11 09	11 17	11 21	11 26
10	10 28	10 40	10 50	10 58	11 05	11 11	11 21	11 31	11 39	11 48	11 58	12 09	12 15	12 22
11	10 55	11 10	11 22	11 33	11 41	11 49	12 02	12 14	12 24	12 35	12 47	13 01	13 08	13 17
12	11 27	11 45	11 59	12 11	12 21	12 30	12 45	12 59	13 11	13 24	13 37	13 53	14 02	14 12
13	12 06	12 26	12 41	12 54	13 05	13 15	13 32	13 46	14 00	14 13	14 28	14 45	14 55	15 06
14	12 53	13 13	13 30	13 43	13 54	14 04	14 21	14 36	14 50	15 04	15 19	15 36	15 46	15 58
15	13 48	14 08	14 24	14 37	14 48	14 58	15 14	15 29	15 42	15 56	16 10	16 27	16 36	16 47
16	14 52	15 10	15 24	15 36	15 46	15 55	16 10	16 23	16 35	16 47	17 00	17 15	17 24	17 34
17	16 03	16 18	16 30	16 39	16 47	16 55	17 07	17 18	17 28	17 38	17 49	18 01	18 09	18 17

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	9 56	9 54	9 53	9 52	9 51	9 50	9 48	9 47	9 45	9 44	9 42	9 41	9 40	9 39
25	10 20	10 23	10 25	10 27	10 29	10 30	10 32	10 35	10 37	10 39	10 41	10 43	10 45	10 46
26	10 46	10 53	10 58	11 03	11 08	11 11	11 18	11 23	11 29	11 34	11 40	11 46	11 50	11 54
27	11 14	11 25	11 34	11 42	11 49	11 54	12 05	12 13	12 22	12 30	12 39	12 49	12 55	13 02
28	11 46	12 02	12 14	12 24	12 33	12 41	12 54	13 06	13 17	13 28	13 39	13 53	14 00	14 09
29	12 25	12 44	12 59	13 11	13 21	13 30	13 46	14 00	14 13	14 26	14 39	14 55	15 04	15 15
30	13 12	13 33	13 49	14 03	14 14	14 24	14 41	14 56	15 10	15 24	15 39	15 56	16 06	16 17
31	14 08	14 29	14 46	14 59	15 11	15 21	15 38	15 53	16 07	16 21	16 36	16 53	17 03	17 14
Aug. 1	15 12	15 32	15 47	16 00	16 10	16 20	16 36	16 50	17 03	17 16	17 30	17 46	17 55	18 05
2	16 21	16 38	16 51	17 02	17 11	17 19	17 33	17 45	17 57	18 08	18 20	18 34	18 41	18 50
3	17 32	17 45	17 56	18 04	18 12	18 18	18 29	18 39	18 48	18 57	19 06	19 17	19 23	19 30
4	18 43	18 52	19 00	19 06	19 11	19 15	19 23	19 30	19 36	19 43	19 49	19 57	20 01	20 06
5	19 54	19 58	20 02	20 06	20 08	20 11	20 15	20 19	20 22	20 26	20 29	20 34	20 36	20 39
6	21 02	21 03	21 04	21 04	21 05	21 05	21 06	21 06	21 07	21 07	21 08	21 09	21 09	21 09
7	22 09	22 06	22 03	22 01	21 59	21 58	21 55	21 53	21 50	21 48	21 45	21 43	21 41	21 39
8	23 15	23 08	23 02	22 58	22 54	22 50	22 44	22 38	22 33	22 28	22 23	22 17	22 13	22 09
9	.. ..	.. ..	.. ..	23 53	23 47	23 42	23 32	23 24	23 17	23 09	23 01	22 52	22 46	22 40
10	0 20	0 09	0 00	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 51	23 41	23 28	23 22	23 14
11	1 24	1 09	0 58	0 49	0 41	0 34	0 21	0 11	0 01	.. ..	.. ..	.. ..	.. ..	23 50
12	2 26	2 09	1 55	1 44	1 34	1 26	1 11	0 59	0 47	0 35	0 22	0 08	0 00	.. ..
13	3 25	3 06	2 51	2 38	2 27	2 18	2 02	1 48	1 34	1 21	1 07	0 51	0 42	0 31
14	4 21	4 00	3 44	3 31	3 19	3 10	2 53	2 38	2 24	2 10	1 55	1 38	1 28	1 17
15	5 11	4 51	4 35	4 22	4 10	4 00	3 44	3 29	3 15	3 01	2 46	2 29	2 19	2 08
16	5 55	5 36	5 22	5 09	4 59	4 50	4 34	4 20	4 07	3 54	3 40	3 24	3 15	3 04
17	6 32	6 17	6 04	5 54	5 45	5 37	5 24	5 12	5 00	4 49	4 37	4 23	4 15	4 06

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	22 11	22 11	22 11	22 11	22 11	22 10	22 10	22 10	22 10	22 10	22 10	22 10	22 09	22 09
25	22 47	22 45	22 44	22 43	22 41	22 40	22 38	22 36	22 34	22 31	22 29	22 26	22 23	22 19
26	23 24	23 22	23 19	23 16	23 14	23 10	23 07	23 03	22 59	22 55	22 50	22 44	22 38	22 30
27	.. ..	.. ..	23 57	23 53	23 49	23 45	23 40	23 34	23 29	23 22	23 14	23 06	22 56	22 44
28	0 04	0 01	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 55	23 45	23 33	23 20	23 04
29	0 49	0 44	0 40	0 35	0 30	0 24	0 18	0 11	0 03	.. ..	.. ..	.. ..	23 54	23 34
30	1 38	1 33	1 28	1 22	1 16	1 10	1 02	0 54	0 45	0 35	0 24	0 10	.. ..	.. ..
31	2 32	2 27	2 22	2 16	2 09	2 02	1 55	1 46	1 37	1 26	1 13	0 59	0 41	0 19
Aug. 1	3 31	3 26	3 21	3 15	3 09	3 02	2 54	2 46	2 37	2 26	2 14	2 00	1 43	1 21
2	4 32	4 28	4 23	4 18	4 12	4 06	4 00	3 52	3 44	3 35	3 24	3 12	2 57	2 39
3	5 34	5 31	5 27	5 23	5 18	5 13	5 08	5 02	4 55	4 48	4 39	4 29	4 18	4 04
4	6 36	6 34	6 31	6 28	6 24	6 21	6 17	6 12	6 07	6 02	5 56	5 49	5 40	5 31
5	7 37	7 35	7 34	7 32	7 29	7 27	7 25	7 22	7 19	7 15	7 12	7 07	7 02	6 56
6	8 36	8 36	8 35	8 34	8 33	8 32	8 31	8 30	8 29	8 28	8 26	8 24	8 22	8 20
7	9 34	9 34	9 35	9 35	9 35	9 36	9 36	9 37	9 37	9 38	9 39	9 40	9 41	9 42
8	10 31	10 32	10 33	10 35	10 36	10 38	10 40	10 42	10 45	10 47	10 50	10 54	10 58	11 02
9	11 26	11 29	11 31	11 34	11 37	11 40	11 43	11 47	11 51	11 56	12 01	12 07	12 13	12 21
10	12 22	12 25	12 29	12 32	12 36	12 41	12 45	12 50	12 56	13 03	13 10	13 18	13 28	13 40
11	13 17	13 21	13 26	13 30	13 35	13 40	13 46	13 53	14 00	14 08	14 18	14 29	14 42	14 57
12	14 12	14 17	14 22	14 27	14 33	14 39	14 46	14 54	15 02	15 12	15 23	15 36	15 52	16 11
13	15 06	15 11	15 16	15 22	15 28	15 35	15 43	15 51	16 00	16 11	16 24	16 38	16 56	17 18
14	15 58	16 03	16 08	16 14	16 21	16 28	16 35	16 44	16 54	17 05	17 17	17 32	17 50	18 13
15	16 47	16 52	16 57	17 03	17 09	17 16	17 23	17 31	17 40	17 51	18 03	18 17	18 33	18 54
16	17 34	17 38	17 43	17 48	17 53	17 59	18 05	18 13	18 21	18 30	18 40	18 52	19 06	19 23
17	18 17	18 20	18 24	18 28	18 33	18 37	18 43	18 48	18 55	19 02	19 10	19 19	19 30	19 43

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	9 39	9 38	9 38	9 37	9 36	9 36	9 35	9 34	9 33	9 32	9 31	9 30	9 28	9 26
25	10 46	10 47	10 47	10 48	10 49	10 50	10 51	10 52	10 53	10 55	10 56	10 58	11 00	11 02
26	11 54	11 56	11 58	12 00	12 02	12 05	12 07	12 10	12 14	12 17	12 22	12 26	12 32	12 38
27	13 02	13 05	13 08	13 12	13 15	13 19	13 24	13 28	13 34	13 40	13 47	13 54	14 03	14 14
28	14 09	14 13	14 17	14 22	14 27	14 32	14 38	14 45	14 52	15 00	15 09	15 20	15 33	15 48
29	15 15	15 20	15 25	15 30	15 36	15 42	15 49	15 57	16 06	16 16	16 27	16 40	16 56	17 16
30	16 17	16 22	16 27	16 33	16 40	16 47	16 54	17 03	17 12	17 23	17 35	17 50	18 08	18 30
31	17 14	17 19	17 25	17 30	17 37	17 43	17 51	17 59	18 09	18 20	18 32	18 46	19 04	19 25
Aug. 1	18 05	18 10	18 15	18 20	18 26	18 32	18 39	18 47	18 55	19 05	19 16	19 29	19 44	20 03
2	18 50	18 54	18 59	19 03	19 08	19 13	19 19	19 26	19 33	19 41	19 50	20 00	20 13	20 27
3	19 30	19 33	19 37	19 40	19 44	19 48	19 53	19 58	20 03	20 09	20 16	20 24	20 33	20 44
4	20 06	20 08	20 10	20 13	20 15	20 18	20 21	20 25	20 29	20 33	20 37	20 43	20 49	20 56
5	20 39	20 40	20 41	20 42	20 44	20 45	20 47	20 49	20 51	20 53	20 55	20 58	21 01	21 05
6	21 09	21 09	21 10	21 10	21 10	21 10	21 10	21 11	21 11	21 11	21 12	21 12	21 12	21 13
7	21 39	21 38	21 37	21 37	21 36	21 34	21 33	21 32	21 31	21 29	21 27	21 25	21 23	21 21
8	22 09	22 07	22 05	22 03	22 01	21 59	21 56	21 54	21 51	21 47	21 43	21 39	21 34	21 29
9	22 40	22 38	22 35	22 32	22 29	22 25	22 21	22 17	22 12	22 07	22 01	21 55	21 47	21 38
10	23 14	23 10	23 06	23 02	22 58	22 53	22 48	22 43	22 37	22 30	22 22	22 13	22 02	21 50
11	23 50	23 46	23 42	23 37	23 31	23 26	23 20	23 13	23 05	22 56	22 47	22 35	22 22	22 06
12	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 56	23 48	23 39	23 29	23 18	23 05	22 49	22 29
13	0 31	0 26	0 21	0 16	0 10	0 03	.. ..	.. ..	.. ..	.. ..	23 58	23 43	23 26	23 04
14	1 17	1 12	1 06	1 00	0 54	0 47	0 39	0 31	0 21	0 11	.. ..	.. ..	.. ..	23 54
15	2 08	2 03	1 57	1 51	1 45	1 38	1 30	1 22	1 12	1 01	0 49	0 34	0 16	.. ..
16	3 04	3 00	2 55	2 49	2 43	2 37	2 29	2 21	2 13	2 02	1 51	1 37	1 21	1 00
17	4 06	4 02	3 57	3 52	3 47	3 42	3 35	3 29	3 21	3 12	3 03	2 51	2 38	2 21

... .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	14 52	15 10	15 24	15 36	15 46	15 55	16 10	16 23	16 35	16 47	17 00	17 15	17 24	17 34
17	16 03	16 18	16 30	16 39	16 47	16 55	17 07	17 18	17 28	17 38	17 49	18 01	18 09	18 17
18	17 20	17 30	17 38	17 45	17 51	17 57	18 06	18 14	18 21	18 29	18 37	18 46	18 51	18 57
19	18 39	18 45	18 49	18 53	18 57	19 00	19 05	19 10	19 14	19 18	19 23	19 28	19 31	19 35
20	19 59	20 00	20 01	20 02	20 03	20 04	20 05	20 06	20 07	20 08	20 09	20 10	20 10	20 11
21	21 21	21 17	21 14	21 12	21 10	21 08	21 05	21 02	20 59	20 57	20 54	20 51	20 50	20 48
22	22 42	22 33	22 26	22 21	22 16	22 12	22 05	21 58	21 53	21 47	21 41	21 34	21 30	21 25
23	.. ..	23 48	23 38	23 30	23 22	23 16	23 05	22 56	22 47	22 38	22 28	22 18	22 12	22 05
24	0 01	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 53	23 42	23 30	23 18	23 05	22 57	22 48
25	1 18	1 01	0 48	0 37	0 28	0 19	0 05	.. ..	.. ..	.. ..	.. ..	23 55	23 46	23 35
26	2 29	2 09	1 54	1 41	1 30	1 21	1 05	0 51	0 38	0 25	0 11	.. ..	.. ..	.. ..
27	3 32	3 11	2 55	2 42	2 30	2 20	2 03	1 48	1 34	1 20	1 05	0 48	0 38	0 27
28	4 26	4 06	3 50	3 36	3 25	3 15	2 58	2 44	2 30	2 16	2 01	1 44	1 34	1 23
29	5 11	4 52	4 38	4 26	4 15	4 06	3 50	3 37	3 24	3 11	2 57	2 42	2 33	2 22
30	5 47	5 32	5 19	5 09	5 00	4 52	4 39	4 27	4 16	4 05	3 53	3 40	3 32	3 23
31	6 17	6 05	5 56	5 48	5 41	5 35	5 24	5 15	5 06	4 57	4 48	4 38	4 31	4 24
Sept. 1	6 43	6 35	6 28	6 23	6 18	6 14	6 06	6 00	5 54	5 48	5 41	5 34	5 30	5 25
2	7 06	7 01	6 58	6 55	6 52	6 50	6 46	6 43	6 40	6 36	6 33	6 29	6 27	6 24
3	7 27	7 26	7 26	7 26	7 25	7 25	7 25	7 24	7 24	7 24	7 24	7 23	7 23	7 23
4	7 47	7 50	7 53	7 55	7 57	7 59	8 02	8 05	8 07	8 10	8 13	8 16	8 18	8 20
5	8 08	8 15	8 21	8 26	8 30	8 33	8 40	8 45	8 51	8 56	9 02	9 08	9 12	9 16
6	8 31	8 41	8 50	8 57	9 03	9 09	9 18	9 26	9 34	9 42	9 50	10 00	10 06	10 12
7	8 56	9 10	9 21	9 31	9 39	9 46	9 58	10 08	10 19	10 29	10 39	10 52	10 59	11 07
8	9 26	9 43	9 56	10 07	10 17	10 25	10 40	10 52	11 04	11 16	11 29	11 44	11 52	12 02
9	10 01	10 20	10 35	10 48	10 59	11 08	11 24	11 38	11 51	12 04	12 19	12 35	12 44	12 55

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	5 55	5 36	5 22	5 09	4 59	4 50	4 34	4 20	4 07	3 54	3 40	3 24	3 15	3 04
17	6 32	6 17	6 04	5 54	5 45	5 37	5 24	5 12	5 00	4 49	4 37	4 23	4 15	4 06
18	7 05	6 53	6 43	6 35	6 28	6 22	6 12	6 02	5 53	5 45	5 35	5 24	5 18	5 10
19	7 34	7 26	7 20	7 14	7 10	7 06	6 59	6 52	6 46	6 40	6 34	6 27	6 22	6 18
20	8 00	7 56	7 54	7 51	7 49	7 48	7 44	7 42	7 39	7 36	7 33	7 30	7 28	7 26
21	8 25	8 26	8 27	8 28	8 28	8 29	8 30	8 31	8 32	8 32	8 33	8 34	8 35	8 35
22	8 51	8 56	9 01	9 05	9 08	9 11	9 16	9 20	9 25	9 29	9 33	9 38	9 41	9 45
23	9 18	9 28	9 36	9 43	9 49	9 54	10 03	10 11	10 18	10 26	10 33	10 42	10 48	10 54
24	9 49	10 03	10 15	10 24	10 32	10 39	10 52	11 03	11 13	11 23	11 34	11 46	11 53	12 02
25	10 26	10 44	10 58	11 09	11 19	11 28	11 43	11 56	12 08	12 21	12 34	12 49	12 58	13 08
26	11 10	11 30	11 46	11 59	12 10	12 20	12 36	12 51	13 05	13 18	13 33	13 49	13 59	14 10
27	12 02	12 23	12 39	12 53	13 04	13 14	13 32	13 47	14 01	14 15	14 30	14 47	14 57	15 08
28	13 02	13 22	13 38	13 51	14 02	14 11	14 28	14 42	14 56	15 09	15 24	15 40	15 49	16 00
29	14 08	14 25	14 39	14 51	15 01	15 10	15 24	15 37	15 49	16 01	16 14	16 29	16 37	16 46
30	15 17	15 31	15 43	15 52	16 00	16 08	16 20	16 31	16 41	16 50	17 01	17 13	17 20	17 28
31	16 27	16 38	16 46	16 53	17 00	17 05	17 14	17 22	17 29	17 37	17 45	17 54	17 59	18 04
Sept. 1	17 37	17 44	17 49	17 54	17 57	18 01	18 06	18 11	18 16	18 21	18 26	18 31	18 34	18 38
2	18 46	18 49	18 51	18 53	18 54	18 55	18 58	18 59	19 01	19 03	19 05	19 07	19 08	19 09
3	19 54	19 53	19 51	19 50	19 50	19 49	19 47	19 46	19 45	19 44	19 43	19 41	19 40	19 39
4	21 01	20 55	20 51	20 47	20 44	20 41	20 37	20 32	20 28	20 24	20 20	20 15	20 13	20 09
5	22 06	21 57	21 49	21 43	21 38	21 33	21 25	21 18	21 12	21 05	20 58	20 50	20 45	20 40
6	23 10	22 57	22 47	22 39	22 32	22 25	22 14	22 04	21 55	21 46	21 37	21 26	21 20	21 13
7	.. ..	23 57	23 44	23 34	23 25	23 17	23 03	22 51	22 40	22 29	22 18	22 04	21 56	21 47
8	0 13	.. ..	.. ..	.. ..	.. ..	.. ..	23 53	23 39	23 27	23 14	23 01	22 45	22 36	22 26
9	1 13	0 54	0 40	0 28	0 17	0 08	.. ..	.. ..	.. ..	.. ..	23 46	23 30	23 20	23 09

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

53

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	17 34	17 38	17 43	17 48	17 53	17 59	18 05	18 13	18 21	18 30	18 40	18 52	19 06	19 23
17	18 17	18 20	18 24	18 28	18 33	18 37	18 43	18 48	18 55	19 02	19 10	19 19	19 30	19 43
18	18 57	18 59	19 02	19 05	19 08	19 12	19 16	19 20	19 24	19 29	19 35	19 41	19 49	19 57
19	19 35	19 36	19 38	19 39	19 41	19 43	19 45	19 48	19 50	19 53	19 57	20 00	20 04	20 09
20	20 11	20 12	20 12	20 12	20 13	20 13	20 14	20 14	20 15	20 16	20 16	20 17	20 18	20 19
21	20 48	20 47	20 46	20 45	20 44	20 43	20 42	20 41	20 39	20 38	20 36	20 34	20 32	20 29
22	21 25	21 23	21 21	21 19	21 16	21 14	21 11	21 08	21 05	21 01	20 57	20 52	20 46	20 40
23	22 05	22 02	21 59	21 55	21 51	21 47	21 43	21 38	21 33	21 27	21 20	21 13	21 04	20 53
24	22 48	22 44	22 40	22 35	22 30	22 25	22 19	22 13	22 06	21 58	21 49	21 38	21 26	21 11
25	23 35	23 31	23 26	23 20	23 14	23 08	23 01	22 54	22 45	22 35	22 24	22 11	21 56	21 38
26	.. ..	.. ..	.. ..	.. ..	.. ..	23 58	23 50	23 42	23 32	23 22	23 09	22 55	22 38	22 16
27	0 27	0 22	0 17	0 11	0 05	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 51	23 33	23 12
28	1 23	1 18	1 13	1 07	1 01	0 54	0 46	0 38	0 28	0 18	0 05	.. ..	.. ..	.. ..
29	2 22	2 18	2 13	2 07	2 01	1 55	1 48	1 40	1 32	1 22	1 11	0 58	0 42	0 23
30	3 23	3 19	3 15	3 10	3 05	3 00	2 54	2 48	2 40	2 32	2 23	2 12	1 59	1 44
31	4 24	4 21	4 18	4 14	4 10	4 06	4 02	3 57	3 51	3 45	3 38	3 29	3 20	3 09
Sept. 1	5 25	5 23	5 21	5 18	5 15	5 13	5 09	5 06	5 02	4 58	4 53	4 48	4 41	4 34
2	6 24	6 23	6 22	6 21	6 19	6 18	6 16	6 15	6 13	6 10	6 08	6 05	6 02	5 58
3	7 23	7 23	7 23	7 22	7 22	7 22	7 22	7 22	7 22	7 22	7 22	7 21	7 21	7 21
4	8 20	8 21	8 22	8 23	8 24	8 25	8 27	8 28	8 30	8 32	8 34	8 36	8 39	8 42
5	9 16	9 18	9 20	9 23	9 25	9 27	9 30	9 33	9 37	9 40	9 45	9 50	9 55	10 02
6	10 12	10 15	10 18	10 21	10 25	10 29	10 33	10 37	10 42	10 48	10 55	11 02	11 10	11 20
7	11 07	11 11	11 15	11 19	11 24	11 29	11 34	11 40	11 47	11 54	12 03	12 13	12 24	12 38
8	12 02	12 06	12 11	12 16	12 21	12 27	12 34	12 41	12 49	12 58	13 09	13 21	13 35	13 53
9	12 55	13 00	13 05	13 11	13 17	13 24	13 31	13 39	13 48	13 59	14 10	14 24	14 41	15 02

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	3 04	3 00	2 55	2 49	2 43	2 37	2 29	2 21	2 13	2 02	1 51	1 37	1 21	1 00
17	4 06	4 02	3 57	3 50	3 47	3 42	3 35	3 29	3 21	3 12	3 03	2 51	2 38	2 21
18	5 10	5 07	5 04	5 02	4 56	4 52	4 47	4 42	4 36	4 29	4 22	4 13	4 03	3 51
19	6 18	6 15	6 13	6 11	6 08	6 05	6 02	5 58	5 55	5 50	5 45	5 40	5 34	5 26
20	7 26	7 25	7 24	7 23	7 22	7 20	7 19	7 17	7 16	7 14	7 12	7 09	7 06	7 03
21	8 35	8 35	8 36	8 36	8 36	8 37	8 37	8 37	8 38	8 38	8 39	8 39	8 40	8 41
22	9 45	9 46	9 48	9 49	9 51	9 53	9 55	9 58	10 00	10 03	10 06	10 10	10 14	10 19
23	10 54	10 56	10 59	11 02	11 05	11 09	11 13	11 17	11 22	11 27	11 33	11 40	11 47	11 57
24	12 02	12 05	12 09	12 13	12 18	12 23	12 28	12 34	12 41	12 48	12 57	13 07	13 18	13 32
25	13 08	13 12	13 17	13 22	13 28	13 34	13 40	13 48	13 56	14 05	14 16	14 29	14 43	15 02
26	14 10	14 15	14 21	14 26	14 32	14 39	14 47	14 55	15 04	15 15	15 27	15 41	15 58	16 19
27	15 08	15 13	15 18	15 24	15 31	15 38	15 45	15 54	16 03	16 14	16 26	16 41	16 58	17 20
28	16 00	16 05	16 10	16 16	16 22	16 28	16 35	16 43	16 52	17 02	17 14	17 27	17 43	18 03
29	16 46	16 51	16 55	17 00	17 05	17 11	17 17	17 24	17 32	17 41	17 50	18 02	18 15	18 31
30	17 28	17 31	17 35	17 39	17 43	17 48	17 53	17 58	18 04	18 11	18 19	18 28	18 38	18 50
31	18 04	18 07	18 10	18 13	18 16	18 19	18 23	18 27	18 31	18 36	18 42	18 48	18 55	19 03
Sept. 1	18 38	18 39	18 41	18 43	18 45	18 47	18 49	18 52	18 54	18 57	19 01	19 04	19 09	19 14
2	19 09	19 10	19 10	19 11	19 12	19 13	19 13	19 14	19 15	19 16	19 18	19 19	19 21	19 22
3	19 39	19 39	19 39	19 38	19 38	19 37	19 37	19 36	19 35	19 34	19 34	19 33	19 31	19 30
4	20 09	20 08	20 07	20 05	20 03	20 02	20 00	19 57	19 55	19 52	19 50	19 46	19 42	19 38
5	20 40	20 38	20 35	20 33	20 30	20 27	20 24	20 20	20 16	20 12	20 07	20 01	19 54	19 47
6	21 13	21 09	21 06	21 02	20 59	20 54	20 50	20 45	20 39	20 33	20 26	20 18	20 08	19 58
7	21 47	21 44	21 39	21 35	21 30	21 25	21 19	21 13	21 06	20 58	20 49	20 38	20 26	20 12
8	22 26	22 21	22 17	22 11	22 06	22 00	21 53	21 45	21 37	21 27	21 17	21 04	20 49	20 31
9	23 09	23 04	22 59	22 53	22 47	22 40	22 32	22 24	22 15	22 04	21 52	21 38	21 21	21 00

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	9 26	9 43	9 56	10 07	10 17	10 25	10 40	10 52	11 04	11 16	11 29	11 44	11 52	12 02
9	10 01	10 20	10 35	10 48	10 59	11 08	11 24	11 38	11 51	12 04	12 19	12 35	12 44	12 55
10	10 43	11 04	11 20	11 33	11 44	11 54	12 11	12 26	12 40	12 54	13 09	13 26	13 36	13 47
11	11 34	11 55	12 11	12 24	12 35	12 45	13 02	13 16	13 30	13 44	13 59	14 16	14 26	14 37
12	12 33	12 52	13 07	13 20	13 30	13 39	13 55	14 09	14 22	14 35	14 49	15 04	15 14	15 24
13	13 40	13 57	14 10	14 20	14 29	14 37	14 51	15 03	15 14	15 26	15 38	15 51	15 59	16 08
14	14 54	15 07	15 17	15 25	15 32	15 38	15 49	15 59	16 07	16 16	16 26	16 36	16 42	16 49
15	16 12	16 21	16 27	16 33	16 37	16 41	16 49	16 55	17 01	17 07	17 13	17 20	17 24	17 29
16	17 34	17 37	17 40	17 42	17 44	17 46	17 49	17 52	17 54	17 57	18 00	18 03	18 04	18 06
17	18 57	18 56	18 54	18 53	18 53	18 52	18 51	18 49	18 48	18 47	18 46	18 45	18 45	18 44
18	20 21	20 15	20 09	20 05	20 01	19 58	19 53	19 48	19 43	19 39	19 34	19 29	19 25	19 22
19	21 44	21 33	21 24	21 17	21 10	21 05	20 55	20 47	20 39	20 31	20 23	20 14	20 08	20 02
20	23 05	22 49	22 37	22 27	22 18	22 10	21 57	21 46	21 35	21 25	21 14	21 01	20 54	20 45
21	.. ..	.. ..	23 46	23 34	23 23	23 14	22 59	22 45	22 32	22 20	22 06	21 51	21 42	21 32
22	0 20	0 01	.. ..	.. ..	.. ..	.. ..	23 58	23 43	23 30	23 16	23 01	22 44	22 35	22 23
23	1 27	1 06	0 50	0 36	0 25	0 15	.. ..	.. ..	.. ..	.. ..	23 57	23 40	23 30	23 19
24	2 24	2 03	1 47	1 33	1 22	1 12	0 55	0 40	0 26	0 12	.. ..	.. ..	.. ..	.. ..
25	3 11	2 52	2 37	2 24	2 13	2 04	1 48	1 34	1 20	1 07	0 53	0 37	0 27	0 17
26	3 49	3 33	3 20	3 09	2 59	2 51	2 37	2 24	2 13	2 01	1 49	1 34	1 26	1 16
27	4 21	4 07	3 57	3 48	3 41	3 34	3 22	3 12	3 03	2 53	2 43	2 31	2 25	2 17
28	4 47	4 38	4 30	4 24	4 18	4 13	4 05	3 57	3 50	3 43	3 36	3 27	3 22	3 17
29	5 10	5 05	5 00	4 56	4 53	4 50	4 45	4 40	4 36	4 32	4 27	4 22	4 19	4 16
30	5 31	5 30	5 28	5 27	5 26	5 25	5 23	5 22	5 20	5 19	5 18	5 16	5 15	5 14
Oct. 1	5 52	5 54	5 55	5 57	5 58	5 59	6 01	6 02	6 04	6 05	6 07	6 09	6 10	6 11
2	6 12	6 18	6 23	6 27	6 30	6 33	6 38	6 43	6 47	6 51	6 56	7 01	7 05	7 08

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	0 13	.. ..	.. ..	.. ..	.. ..	.. ..	23 53	23 39	23 27	23 14	23 01	22 45	22 36	22 26
9	1 13	0 54	0 40	0 28	0 17	0 08	.. ..	.. ..	.. ..	.. ..	23 46	23 30	23 20	23 09
10	2 10	1 49	1 33	1 20	1 09	0 59	0 43	0 28	0 15	0 01	.. ..	.. ..	.. ..	23 57
11	3 01	2 41	2 24	2 11	2 00	1 50	1 33	1 18	1 04	0 50	0 35	0 18	0 08	.. ..
12	3 47	3 28	3 12	2 59	2 49	2 39	2 23	2 08	1 55	1 41	1 27	1 10	1 01	0 50
13	4 27	4 10	3 56	3 45	3 35	3 27	3 12	2 59	2 47	2 35	2 22	2 07	1 58	1 48
14	5 02	4 48	4 37	4 28	4 20	4 13	4 00	3 50	3 40	3 30	3 19	3 06	2 59	2 51
15	5 32	5 22	5 14	5 08	5 02	4 57	4 48	4 40	4 33	4 25	4 17	4 08	4 03	3 57
16	6 00	5 54	5 50	5 46	5 43	5 40	5 35	5 30	5 26	5 22	5 17	5 12	5 09	5 06
17	6 26	6 25	6 24	6 23	6 23	6 22	6 21	6 21	6 20	6 19	6 18	6 17	6 17	6 16
18	6 52	6 55	6 58	7 01	7 03	7 05	7 09	7 11	7 14	7 17	7 20	7 23	7 25	7 27
19	7 19	7 28	7 34	7 40	7 45	7 49	7 57	8 03	8 09	8 16	8 22	8 30	8 34	8 39
20	7 50	8 03	8 13	8 21	8 29	8 35	8 46	8 56	9 06	9 15	9 25	9 36	9 43	9 50
21	8 26	8 42	8 55	9 06	9 16	9 24	9 38	9 51	10 02	10 14	10 27	10 41	10 49	10 59
22	9 08	9 27	9 43	9 56	10 06	10 16	10 32	10 46	11 00	11 13	11 27	11 44	11 53	12 04
23	9 58	10 19	10 35	10 49	11 00	11 10	11 28	11 43	11 57	12 11	12 26	12 43	12 53	13 04
24	10 56	11 16	11 32	11 46	11 57	12 07	12 24	12 38	12 52	13 06	13 20	13 37	13 47	13 58
25	11 59	12 18	12 33	12 45	12 55	13 04	13 20	13 33	13 46	13 58	14 12	14 27	14 36	14 46
26	13 07	13 23	13 35	13 45	13 54	14 02	14 15	14 26	14 37	14 48	14 59	15 12	15 19	15 28
27	14 16	14 28	14 38	14 46	14 52	14 58	15 09	15 17	15 26	15 34	15 43	15 53	15 59	16 05
28	15 26	15 34	15 40	15 45	15 50	15 54	16 01	16 07	16 13	16 18	16 24	16 31	16 35	16 39
29	16 34	16 38	16 41	16 44	16 46	16 48	16 52	16 55	16 58	17 00	17 03	17 07	17 08	17 11
30	17 42	17 42	17 42	17 42	17 42	17 42	17 42	17 42	17 41	17 41	17 41	17 41	17 41	17 41
Oct. 1	18 49	18 45	18 42	18 39	18 36	18 34	18 31	18 28	18 25	18 22	18 19	18 15	18 13	18 11
2	19 55	19 47	19 40	19 35	19 31	19 27	19 20	19 14	19 08	19 02	18 56	18 49	18 45	18 41

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

55

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	12 02	12 06	12 11	12 16	12 21	12 27	12 34	12 41	12 49	12 58	13 09	13 21	13 35	13 53
9	12 55	13 00	13 05	13 11	13 17	13 24	13 31	13 39	13 48	13 59	14 10	14 24	14 41	15 02
10	13 47	13 52	13 58	14 04	14 10	14 17	14 25	14 33	14 43	14 54	15 06	15 21	15 39	16 02
11	14 37	14 42	14 47	14 53	14 59	15 06	15 14	15 22	15 32	15 42	15 55	16 09	16 27	16 48
12	15 24	15 29	15 34	15 39	15 45	15 51	15 58	16 06	16 14	16 24	16 35	16 48	17 03	17 22
13	16 08	16 12	16 16	16 21	16 26	16 31	16 37	16 44	16 51	16 59	17 08	17 19	17 31	17 46
14	16 49	16 53	16 56	16 59	17 03	17 07	17 12	17 17	17 22	17 28	17 35	17 43	17 52	18 03
15	17 29	17 31	17 33	17 35	17 38	17 40	17 43	17 47	17 50	17 54	17 58	18 03	18 09	18 16
16	18 06	18 07	18 08	18 09	18 10	18 12	18 13	18 14	18 16	18 17	18 19	18 21	18 24	18 27
17	18 44	18 44	18 43	18 43	18 43	18 42	18 42	18 41	18 41	18 40	18 39	18 39	18 38	18 37
18	19 22	19 21	19 19	19 17	19 15	19 13	19 11	19 09	19 06	19 03	19 00	18 57	18 52	18 48
19	20 02	19 59	19 57	19 54	19 50	19 47	19 43	19 39	19 34	19 29	19 23	19 17	19 09	19 00
20	20 45	20 42	20 38	20 33	20 29	20 24	20 19	20 13	20 06	19 59	19 51	19 41	19 30	19 17
21	21 32	21 28	21 23	21 18	21 12	21 06	21 00	20 52	20 44	20 35	20 24	20 12	19 58	19 41
22	22 23	22 18	22 13	22 07	22 01	21 54	21 47	21 39	21 30	21 19	21 07	20 53	20 36	20 15
23	23 19	23 13	23 08	23 02	22 56	22 49	22 41	22 33	22 23	22 12	22 00	21 45	21 28	21 06
24	.. ..	.. ..	.. ..	.. ..	23 55	23 49	23 41	23 33	23 24	23 14	23 03	22 49	22 32	22 12
25	0 17	0 12	0 07	0 01	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 47	23 30
26	1 16	1 12	1 08	1 03	0 58	0 52	0 46	0 39	0 31	0 22	0 12	0 00	.. ..	.. ..
27	2 17	2 13	2 10	2 06	2 02	1 57	1 52	1 46	1 40	1 33	1 25	1 16	1 06	0 53
28	3 17	3 14	3 12	3 09	3 06	3 02	2 59	2 55	2 50	2 45	2 40	2 33	2 26	2 17
29	4 16	4 14	4 13	4 11	4 09	4 07	4 05	4 03	4 00	3 57	3 54	3 50	3 46	3 41
30	5 14	5 14	5 13	5 13	5 12	5 11	5 11	5 10	5 09	5 08	5 07	5 06	5 05	5 04
Oct. 1	6 11	6 12	6 13	6 13	6 14	6 15	6 16	6 16	6 17	6 19	6 20	6 21	6 23	6 25
2	7 08	7 10	7 11	7 13	7 15	7 17	7 19	7 22	7 25	7 28	7 31	7 35	7 40	7 45

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	22 26	22 21	22 17	22 11	22 06	22 00	21 53	21 45	21 37	21 27	21 17	21 04	20 49	20 31
9	23 09	23 04	22 59	22 53	22 47	22 40	22 32	22 24	22 15	22 04	21 52	21 38	21 21	21 00
10	23 57	23 51	23 46	23 40	23 34	23 27	23 19	23 10	23 01	22 50	22 37	22 22	22 04	21 42
11	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 56	23 45	23 33	23 19	22 40
12	0 50	0 45	0 39	0 34	0 28	0 21	0 13	0 05	.. ..	.. ..	.. ..	.. ..	.. ..	23 54
13	1 48	1 43	1 39	1 34	1 28	1 22	1 15	1 08	1 00	0 50	0 39	0 27	0 12	.. ..
14	2 51	2 47	2 43	2 39	2 34	2 29	2 24	2 18	2 11	2 03	1 55	1 45	1 33	1 19
15	3 57	3 54	3 51	3 48	3 45	3 41	3 37	3 33	3 28	3 23	3 16	3 09	3 01	2 52
16	5 06	5 04	5 02	5 01	4 59	4 57	4 54	4 52	4 49	4 46	4 43	4 39	4 34	4 29
17	6 16	6 16	6 15	6 15	6 15	6 14	6 14	6 13	6 13	6 12	6 11	6 11	6 10	6 09
18	7 27	7 28	7 29	7 31	7 32	7 33	7 34	7 36	7 38	7 39	7 42	7 44	7 47	7 50
19	8 39	8 41	8 44	8 46	8 49	8 52	8 55	8 59	9 02	9 07	9 12	9 17	9 24	9 31
20	9 50	9 53	9 57	10 01	10 05	10 09	10 14	10 20	10 26	10 32	10 40	10 49	10 59	11 11
21	10 59	11 03	11 08	11 12	11 18	11 24	11 30	11 37	11 45	11 53	12 04	12 15	12 29	12 46
22	12 04	12 09	12 14	12 20	12 26	12 32	12 40	12 48	12 57	13 07	13 19	13 33	13 49	14 10
23	13 04	13 09	13 14	13 20	13 27	13 34	13 41	13 50	13 59	14 10	14 23	14 37	14 55	15 17
24	13 58	14 03	14 08	14 14	14 20	14 27	14 34	14 42	14 51	15 02	15 14	15 27	15 44	16 05
25	14 46	14 50	14 55	15 00	15 05	15 11	15 18	15 25	15 33	15 42	15 53	16 05	16 19	16 36
26	15 28	15 31	15 35	15 40	15 44	15 49	15 55	16 01	16 07	16 15	16 23	16 33	16 44	16 57
27	16 05	16 08	16 11	16 14	16 18	16 22	16 26	16 30	16 35	16 41	16 47	16 54	17 02	17 12
28	16 39	16 41	16 43	16 45	16 47	16 50	16 53	16 56	16 59	17 03	17 07	17 11	17 17	17 23
29	17 11	17 12	17 13	17 14	17 15	17 16	17 17	17 19	17 20	17 22	17 24	17 26	17 29	17 32
30	17 41	17 41	17 41	17 41	17 41	17 41	17 40	17 40	17 40	17 40	17 40	17 40	17 40	17 40
Oct. 1	18 11	18 10	18 08	18 07	18 06	18 05	18 03	18 02	18 00	17 58	17 56	17 53	17 50	17 47
2	18 41	18 39	18 37	18 35	18 32	18 30	18 27	18 24	18 20	18 16	18 12	18 07	18 02	17 55

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	5 52	5 54	5 55	5 57	5 58	5 59	6 01	6 02	6 04	6 05	6 07	6 09	6 10	6 11
2	6 12	6 18	6 23	6 27	6 30	6 33	6 38	6 43	6 47	6 51	6 56	7 01	7 05	7 08
3	6 34	6 44	6 51	6 57	7 03	7 08	7 16	7 23	7 30	7 37	7 45	7 53	7 58	8 04
4	6 59	7 11	7 22	7 30	7 37	7 44	7 55	8 05	8 14	8 24	8 34	8 45	8 52	9 00
5	7 26	7 42	7 55	8 05	8 14	8 22	8 36	8 48	8 59	9 11	9 23	9 37	9 45	9 54
6	7 59	8 17	8 32	8 44	8 54	9 03	9 19	9 33	9 46	9 58	10 12	10 28	10 37	10 48
7	8 38	8 58	9 14	9 27	9 38	9 48	10 05	10 19	10 33	10 47	11 02	11 19	11 28	11 40
8	9 24	9 45	10 01	10 14	10 26	10 36	10 53	11 08	11 22	11 36	11 51	12 08	12 18	12 29
9	10 18	10 38	10 54	11 07	11 18	11 27	11 44	11 58	12 12	12 25	12 39	12 56	13 05	13 16
10	11 20	11 38	11 52	12 04	12 14	12 22	12 37	12 50	13 02	13 14	13 27	13 42	13 51	14 01
11	12 29	12 44	12 55	13 05	13 13	13 20	13 33	13 43	13 54	14 04	14 15	14 27	14 34	14 42
12	13 44	13 54	14 03	14 10	14 16	14 21	14 30	14 38	14 46	14 53	15 01	15 10	15 15	15 21
13	15 03	15 09	15 14	15 18	15 21	15 24	15 29	15 34	15 38	15 43	15 47	15 52	15 55	15 59
14	16 25	16 26	16 27	16 28	16 29	16 29	16 30	16 31	16 32	16 33	16 34	16 35	16 35	16 36
15	17 50	17 46	17 43	17 40	17 38	17 36	17 32	17 29	17 27	17 24	17 21	17 18	17 16	17 14
16	19 16	19 07	19 00	18 54	18 48	18 44	18 36	18 29	18 23	18 17	18 10	18 03	17 59	17 54
17	20 41	20 27	20 16	20 07	19 59	19 52	19 41	19 31	19 21	19 12	19 02	18 50	18 44	18 37
18	22 02	21 44	21 30	21 18	21 09	21 00	20 45	20 32	20 20	20 08	19 56	19 41	19 33	19 23
19	23 16	22 55	22 39	22 26	22 15	22 05	21 48	21 33	21 20	21 06	20 52	20 35	20 26	20 15
20	.. ..	23 57	23 41	23 27	23 15	23 05	22 48	22 33	22 18	22 04	21 49	21 32	21 22	21 10
21	0 19	.. ..	.. ..	.. ..	.. ..	.. ..	23 44	23 29	23 15	23 02	22 47	22 30	22 20	22 09
22	1 11	0 50	0 34	0 21	0 10	0 00	.. ..	.. ..	.. ..	23 57	23 44	23 29	23 20	23 10
23	1 52	1 34	1 20	1 09	0 59	0 50	0 35	0 22	0 09	.. ..	.. ..	.. ..	.. ..	.. ..
24	2 25	2 11	1 59	1 50	1 42	1 34	1 22	1 11	1 00	0 50	0 39	0 26	0 19	0 11
25	2 53	2 42	2 34	2 26	2 20	2 15	2 05	1 57	1 49	1 41	1 32	1 23	1 17	1 11

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	18 49	18 45	18 42	18 39	18 36	18 34	18 31	18 28	18 25	18 22	18 19	18 15	18 13	18 11
2	19 55	19 47	19 40	19 35	19 31	19 27	19 20	19 14	19 08	19 02	18 56	18 49	18 45	18 41
3	20 59	20 48	20 39	20 31	20 24	20 19	20 09	20 00	19 52	19 43	19 35	19 25	19 19	19 13
4	22 03	21 48	21 36	21 26	21 18	21 10	20 57	20 46	20 36	20 26	20 15	20 02	19 55	19 46
5	23 04	22 46	22 32	22 20	22 10	22 02	21 47	21 34	21 21	21 09	20 56	20 42	20 33	20 23
6	.. ..	23 41	23 26	23 13	23 02	22 52	22 36	22 22	22 08	21 55	21 41	21 24	21 15	21 04
7	0 01	.. ..	.. ..	.. ..	23 52	23 42	23 25	23 10	22 56	22 42	22 27	22 10	22 00	21 49
8	0 54	0 33	0 17	0 04	.. ..	.. ..	.. ..	23 59	23 46	23 32	23 17	23 00	22 50	22 39
9	1 41	1 21	1 05	0 52	0 41	0 31	0 14	.. ..	.. ..	.. ..	.. ..	23 53	23 44	23 33
10	2 23	2 04	1 50	1 37	1 27	1 18	1 02	0 49	0 36	0 23	0 09	.. ..	.. ..	.. ..
11	2 59	2 43	2 30	2 20	2 11	2 03	1 50	1 38	1 27	1 15	1 03	0 50	0 42	0 32
12	3 30	3 18	3 08	3 00	2 53	2 47	2 37	2 27	2 18	2 09	2 00	1 49	1 43	1 35
13	3 58	3 50	3 44	3 38	3 34	3 30	3 23	3 16	3 11	3 05	2 58	2 51	2 47	2 42
14	4 24	4 21	4 18	4 16	4 14	4 12	4 09	4 06	4 04	4 01	3 58	3 55	3 53	3 51
15	4 50	4 51	4 52	4 53	4 54	4 55	4 56	4 57	4 58	4 59	5 00	5 01	5 01	5 02
16	5 17	5 23	5 28	5 32	5 35	5 38	5 44	5 49	5 53	5 58	6 03	6 08	6 11	6 15
17	5 46	5 57	6 06	6 13	6 19	6 25	6 34	6 43	6 50	6 58	7 07	7 16	7 22	7 28
18	6 20	6 35	6 47	6 57	7 06	7 14	7 27	7 38	7 49	8 00	8 11	8 25	8 32	8 41
19	7 01	7 20	7 34	7 47	7 57	8 06	8 22	8 36	8 49	9 02	9 15	9 31	9 40	9 51
20	7 49	8 10	8 27	8 40	8 52	9 02	9 19	9 34	9 48	10 02	10 17	10 34	10 44	10 55
21	8 46	9 08	9 24	9 38	9 49	9 59	10 17	10 32	10 46	11 00	11 15	11 32	11 42	11 53
22	9 50	10 10	10 25	10 38	10 49	10 58	11 14	11 28	11 42	11 55	12 09	12 24	12 34	12 44
23	10 58	11 15	11 28	11 39	11 48	11 56	12 11	12 23	12 34	12 46	12 58	13 11	13 19	13 28
24	12 07	12 20	12 31	12 40	12 47	12 54	13 05	13 15	13 24	13 33	13 43	13 54	14 00	14 07
25	13 16	13 26	13 33	13 39	13 45	13 49	13 58	14 05	14 11	14 18	14 25	14 32	14 37	14 42

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	6 11	6 12	6 13	6 13	6 14	6 15	6 16	6 16	6 17	6 19	6 20	6 21	6 23	6 25
2	7 08	7 10	7 11	7 13	7 15	7 17	7 19	7 22	7 25	7 28	7 31	7 35	7 40	7 45
3	8 04	8 07	8 09	8 12	8 15	8 19	8 22	8 26	8 31	8 36	8 42	8 48	8 56	9 04
4	9 00	9 03	9 07	9 10	9 15	9 19	9 24	9 30	9 36	9 43	9 51	10 00	10 10	10 23
5	9 54	9 58	10 03	10 08	10 13	10 18	10 25	10 31	10 39	10 48	10 57	11 09	11 22	11 39
6	10 48	10 53	10 58	11 03	11 09	11 15	11 22	11 30	11 39	11 49	12 01	12 14	12 30	12 50
7	11 40	11 45	11 50	11 56	12 02	12 09	12 17	12 25	12 35	12 46	12 58	13 13	13 31	13 53
8	12 29	12 35	12 40	12 46	12 52	12 59	13 07	13 16	13 25	13 36	13 49	14 04	14 22	14 44
9	13 16	13 21	13 27	13 32	13 38	13 45	13 52	14 00	14 09	14 20	14 31	14 45	15 02	15 22
10	14 01	14 05	14 10	14 15	14 20	14 26	14 32	14 39	14 47	14 56	15 06	15 18	15 32	15 49
11	14 42	14 46	14 49	14 53	14 58	15 03	15 08	15 14	15 20	15 27	15 35	15 44	15 55	16 08
12	15 21	15 24	15 27	15 30	15 33	15 36	15 40	15 44	15 49	15 54	15 59	16 06	16 13	16 22
13	15 59	16 00	16 02	16 04	16 06	16 08	16 10	16 12	16 15	16 18	16 21	16 24	16 29	16 33
14	16 36	16 36	16 37	16 37	16 38	16 38	16 38	16 39	16 40	16 40	16 41	16 42	16 43	16 44
15	17 14	17 13	17 12	17 11	17 10	17 09	17 08	17 06	17 05	17 03	17 01	16 59	16 57	16 54
16	17 54	17 52	17 49	17 47	17 44	17 42	17 39	17 35	17 32	17 28	17 23	17 18	17 12	17 05
17	18 37	18 33	18 30	18 26	18 22	18 18	18 13	18 08	18 02	17 56	17 49	17 40	17 31	17 20
18	19 23	19 19	19 15	19 10	19 05	18 59	18 53	18 46	18 38	18 30	18 20	18 09	17 56	17 40
19	20 15	20 10	20 05	19 59	19 53	19 47	19 39	19 31	19 22	19 12	19 00	18 47	18 31	18 11
20	21 10	21 05	21 00	20 54	20 48	20 41	20 33	20 24	20 15	20 04	19 51	19 36	19 18	18 56
21	22 09	22 04	21 59	21 53	21 47	21 40	21 33	21 24	21 15	21 04	20 52	20 38	20 21	19 59
22	23 10	23 05	23 01	22 55	22 50	22 44	22 37	22 30	22 21	22 12	22 01	21 49	21 34	21 16
23	.. ..	.. ..	.. ..	23 59	23 54	23 49	23 44	23 38	23 31	23 23	23 14	23 04	22 53	22 39
24	0 11	0 07	0 03	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
25	1 11	1 08	1 05	1 02	0 58	0 55	0 51	0 46	0 41	0 35	0 29	0 22	0 13	0 03

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	18 11	18 10	18 08	18 07	18 06	18 05	18 03	18 02	18 00	17 58	17 56	17 53	17 50	17 47
2	18 41	18 39	18 37	18 35	18 32	18 30	18 27	18 24	18 20	18 16	18 12	18 07	18 02	17 55
3	19 13	19 10	19 07	19 03	19 00	18 56	18 52	18 47	18 42	18 37	18 30	18 23	18 15	18 05
4	19 46	19 43	19 39	19 35	19 30	19 25	19 20	19 14	19 07	19 00	18 51	18 42	18 31	18 18
5	20 23	20 19	20 14	20 09	20 04	19 58	19 51	19 44	19 36	19 27	19 17	19 05	18 51	18 34
6	21 04	20 59	20 54	20 48	20 42	20 35	20 28	20 20	20 11	20 01	19 49	19 35	19 19	18 59
7	21 49	21 44	21 38	21 32	21 26	21 19	21 11	21 03	20 53	20 42	20 30	20 15	19 57	19 34
8	22 39	22 34	22 28	22 22	22 16	22 09	22 01	21 53	21 43	21 32	21 20	21 05	20 47	20 24
9	23 33	23 29	23 23	23 18	23 12	23 06	22 58	22 51	22 42	22 32	22 20	22 06	21 50	21 30
10	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 55	23 48	23 39	23 30	23 18	23 05	22 49
11	0 32	0 28	0 24	0 19	0 14	0 08	0 02	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
12	1 35	1 32	1 29	1 25	1 21	1 17	1 12	1 07	1 01	0 54	0 47	0 38	0 28	0 16
13	2 42	2 39	2 37	2 35	2 32	2 29	2 26	2 22	2 19	2 14	2 09	2 04	1 58	1 50
14	3 51	3 50	3 49	3 48	3 46	3 45	3 44	3 42	3 40	3 39	3 36	3 34	3 31	3 28
15	5 02	5 02	5 03	5 03	5 03	5 04	5 04	5 05	5 05	5 06	5 06	5 07	5 08	5 09
16	6 15	6 16	6 18	6 20	6 22	6 24	6 26	6 29	6 32	6 35	6 38	6 42	6 47	6 52
17	7 28	7 31	7 34	7 37	7 41	7 45	7 49	7 53	7 59	8 04	8 11	8 18	8 26	8 36
18	8 41	8 45	8 49	8 54	8 58	9 04	9 09	9 16	9 23	9 31	9 40	9 51	10 03	10 18
19	9 51	9 55	10 00	10 06	10 12	10 18	10 25	10 33	10 42	10 52	11 03	11 16	11 32	11 52
20	10 55	11 00	11 06	11 12	11 18	11 25	11 33	11 41	11 51	12 02	12 14	12 29	12 47	13 09
21	11 53	11 58	12 04	12 10	12 16	12 23	12 31	12 39	12 48	12 59	13 12	13 26	13 44	14 05
22	12 44	12 49	12 54	12 59	13 05	13 11	13 18	13 26	13 35	13 44	13 55	14 08	14 24	14 42
23	13 28	13 32	13 37	13 41	13 46	13 52	13 58	14 04	14 11	14 19	14 29	14 39	14 51	15 06
24	14 07	14 10	14 14	14 17	14 21	14 26	14 30	14 35	14 41	14 47	14 54	15 02	15 11	15 22
25	14 42	14 44	14 47	14 49	14 52	14 55	14 58	15 02	15 05	15 10	15 15	15 20	15 26	15 34

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	2 25	2 11	1 59	1 50	1 42	1 34	1 22	1 11	1 00	0 50	0 39	0 26	0 19	0 11
	2 53	2 42	2 34	2 26	2 20	2 15	2 05	1 57	1 49	1 41	1 32	1 23	1 17	1 11
	26 3 16	3 10	3 04	2 59	2 55	2 52	2 45	2 40	2 35	2 30	2 24	2 18	2 14	2 10
	27 3 38	3 35	3 32	3 30	3 28	3 27	3 24	3 21	3 19	3 17	3 14	3 11	3 10	3 08
	28 3 58	3 59	3 59	4 00	4 00	4 00	4 01	4 02	4 02	4 03	4 04	4 04	4 05	4 05
29	4 18	4 22	4 26	4 29	4 32	4 34	4 38	4 42	4 45	4 49	4 52	4 56	4 59	5 02
	30 4 39	4 47	4 54	4 59	5 04	5 08	5 16	5 22	5 28	5 34	5 41	5 48	5 53	5 58
	31 5 02	5 14	5 23	5 31	5 38	5 44	5 54	6 03	6 12	6 20	6 30	6 40	6 47	6 54
	Nov. 1 5 28	5 43	5 55	6 05	6 14	6 21	6 34	6 46	6 56	7 07	7 19	7 32	7 40	7 49
	2 5 59	6 17	6 31	6 42	6 52	7 01	7 16	7 30	7 42	7 55	8 08	8 24	8 33	8 43
3	6 35	6 55	7 11	7 24	7 35	7 44	8 01	8 16	8 29	8 43	8 58	9 14	9 24	9 36
	4 7 18	7 39	7 56	8 09	8 21	8 31	8 48	9 03	9 17	9 31	9 47	10 04	10 14	10 26
	5 8 09	8 30	8 46	8 59	9 10	9 20	9 37	9 52	10 06	10 20	10 35	10 52	11 02	11 13
	6 9 07	9 26	9 41	9 53	10 04	10 13	10 29	10 43	10 55	11 08	11 22	11 38	11 47	11 57
	7 10 11	10 28	10 41	10 51	11 00	11 08	11 22	11 34	11 45	11 56	12 08	12 22	12 30	12 39
8	11 22	11 34	11 44	11 53	12 00	12 06	12 17	12 26	12 35	12 44	12 53	13 04	13 10	13 17
	9 12 36	12 45	12 51	12 57	13 02	13 06	13 13	13 19	13 25	13 31	13 38	13 45	13 49	13 54
	10 13 55	13 58	14 01	14 04	14 06	14 08	14 11	14 14	14 17	14 19	14 22	14 26	14 28	14 30
	11 15 16	15 15	15 14	15 13	15 13	15 12	15 11	15 10	15 09	15 09	15 08	15 07	15 07	15 06
	12 16 40	16 34	16 29	16 25	16 22	16 18	16 13	16 08	16 04	16 00	15 55	15 50	15 47	15 44
13	18 06	17 55	17 46	17 39	17 32	17 27	17 17	17 09	17 01	16 53	16 45	16 36	16 30	16 24
	14 19 32	19 16	19 03	18 53	18 44	18 36	18 23	18 11	18 00	17 49	17 38	17 25	17 18	17 09
	15 20 52	20 32	20 17	20 04	19 54	19 44	19 28	19 14	19 01	18 48	18 34	18 19	18 10	17 59
	16 22 04	21 42	21 25	21 11	21 00	20 50	20 32	20 17	20 03	19 48	19 33	19 16	19 06	18 55
	17 23 03	22 42	22 25	22 12	22 00	21 50	21 32	21 17	21 03	20 49	20 33	20 16	20 06	19 54

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	12 07	12 20	12 31	12 40	12 47	12 54	13 05	13 15	13 24	13 33	13 43	13 54	14 00	14 07
	25 13 16	13 26	13 33	13 39	13 45	13 49	13 58	14 05	14 11	14 18	14 25	14 32	14 37	14 42
	26 14 25	14 30	14 35	14 38	14 41	14 44	14 48	14 52	14 56	15 00	15 04	15 08	15 11	15 14
	27 15 33	15 34	15 35	15 36	15 36	15 37	15 38	15 39	15 40	15 41	15 42	15 43	15 43	15 44
	28 16 39	16 37	16 34	16 33	16 31	16 30	16 27	16 25	16 23	16 21	16 19	16 16	16 15	16 13
29	17 45	17 39	17 33	17 29	17 25	17 22	17 16	17 11	17 06	17 01	16 56	16 50	16 47	16 43
	30 18 50	18 40	18 32	18 25	18 19	18 14	18 05	17 57	17 49	17 42	17 34	17 25	17 20	17 14
	31 19 55	19 41	19 29	19 20	19 12	19 05	18 53	18 43	18 33	18 24	18 13	18 01	17 54	17 47
	Nov. 1 20 57	20 40	20 26	20 15	20 05	19 57	19 43	19 30	19 18	19 07	18 54	18 40	18 32	18 22
	2 21 56	21 36	21 21	21 08	20 58	20 48	20 32	20 18	20 05	19 52	19 38	19 22	19 12	19 02
3	22 51	22 30	22 13	22 00	21 48	21 38	21 21	21 06	20 52	20 38	20 23	20 06	19 56	19 45
	4 23 40	23 19	23 02	22 49	22 37	22 27	22 10	21 55	21 41	21 27	21 12	20 54	20 44	20 32
	5 .. ..	.. ..	23 47	23 34	23 24	23 14	22 58	22 43	22 30	22 16	22 02	21 45	21 36	21 24
	6 0 22	0 03	.. ..	.. ..	.. ..	23 59	23 44	23 31	23 19	23 07	22 54	22 39	22 30	22 20
	7 0 59	0 42	0 28	0 17	0 07	.. ..	.. ..	.. ..	.. ..	23 59	23 48	23 36	23 28	23 20
8	1 31	1 17	1 06	0 57	0 49	0 42	0 30	0 19	0 09	.. ..	.. ..	.. ..	.. ..	.. ..
	9 1 59	1 49	1 41	1 34	1 28	1 23	1 14	1 06	0 59	0 52	0 44	0 34	0 29	0 23
	10 2 24	2 19	2 14	2 10	2 07	2 04	1 59	1 54	1 50	1 45	1 41	1 35	1 32	1 28
	11 2 49	2 48	2 47	2 46	2 45	2 45	2 44	2 43	2 42	2 41	2 39	2 38	2 37	2 36
	12 3 14	3 18	3 20	3 23	3 25	3 27	3 30	3 32	3 35	3 38	3 40	3 43	3 45	3 47
13	3 41	3 50	3 56	4 02	4 07	4 11	4 18	4 25	4 31	4 37	4 43	4 51	4 55	5 00
	14 4 12	4 25	4 36	4 44	4 52	4 58	5 10	5 19	5 29	5 38	5 48	6 00	6 06	6 14
	15 4 50	5 07	5 20	5 32	5 41	5 50	6 04	6 17	6 29	6 41	6 54	7 09	7 17	7 27
	16 5 35	5 55	6 11	6 24	6 35	6 45	7 02	7 17	7 30	7 44	7 59	8 16	8 26	8 37
	17 6 30	6 51	7 08	7 22	7 34	7 44	8 02	8 17	8 32	8 46	9 01	9 19	9 29	9 41

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

59

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	0 11	0 07	0 03	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
25	1 11	1 08	1 05	1 02	0 58	0 55	0 51	0 46	0 41	0 35	0 29	0 22	0 13	0 03
26	2 10	2 08	2 06	2 04	2 02	2 00	1 57	1 54	1 51	1 47	1 43	1 39	1 33	1 27
27	3 08	3 07	3 06	3 06	3 05	3 03	3 02	3 01	3 00	2 58	2 56	2 54	2 52	2 49
28	4 05	4 05	4 06	4 06	4 06	4 07	4 07	4 07	4 08	4 08	4 09	4 09	4 10	4 10
29	5 02	5 03	5 04	5 06	5 07	5 09	5 11	5 13	5 15	5 17	5 20	5 23	5 27	5 31
30	5 58	6 00	6 02	6 05	6 08	6 11	6 14	6 17	6 21	6 26	6 31	6 36	6 43	6 50
31	6 54	6 57	7 00	7 04	7 07	7 12	7 16	7 21	7 27	7 33	7 40	7 49	7 58	8 10
Nov. 1	7 49	7 53	7 57	8 01	8 06	8 12	8 17	8 24	8 31	8 39	8 49	8 59	9 12	9 27
2	8 43	8 48	8 52	8 58	9 03	9 10	9 17	9 24	9 33	9 42	9 54	10 07	10 22	10 41
3	9 36	9 41	9 46	9 52	9 58	10 05	10 12	10 21	10 30	10 41	10 54	11 08	11 26	11 48
4	10 26	10 31	10 37	10 43	10 49	10 56	11 04	11 13	11 23	11 34	11 47	12 02	12 20	12 44
5	11 13	11 18	11 24	11 30	11 36	11 43	11 50	11 59	12 08	12 19	12 32	12 46	13 04	13 26
6	11 57	12 02	12 07	12 12	12 18	12 24	12 31	12 39	12 48	12 57	13 08	13 21	13 36	13 55
7	12 39	12 43	12 47	12 51	12 56	13 02	13 07	13 14	13 21	13 29	13 38	13 49	14 01	14 16
8	13 17	13 20	13 24	13 27	13 31	13 35	13 40	13 45	13 50	13 56	14 03	14 11	14 20	14 30
9	13 54	13 56	13 58	14 01	14 03	14 06	14 09	14 12	14 16	14 20	14 24	14 29	14 35	14 42
10	14 30	14 31	14 32	14 33	14 34	14 35	14 37	14 38	14 40	14 42	14 44	14 46	14 49	14 52
11	15 06	15 06	15 06	15 05	15 05	15 05	15 04	15 04	15 04	15 03	15 03	15 02	15 02	15 01
12	15 44	15 42	15 41	15 39	15 37	15 35	15 33	15 31	15 29	15 26	15 23	15 19	15 16	15 11
13	16 24	16 22	16 19	16 16	16 13	16 09	16 05	16 01	15 57	15 51	15 46	15 39	15 32	15 23
14	17 09	17 06	17 02	16 57	16 53	16 48	16 42	16 36	16 30	16 22	16 14	16 04	15 53	15 39
15	17 59	17 55	17 50	17 44	17 39	17 33	17 26	17 18	17 10	17 00	16 49	16 37	16 22	16 04
16	18 55	18 50	18 44	18 38	18 32	18 25	18 17	18 09	17 59	17 48	17 36	17 21	17 03	16 42
17	19 54	19 49	19 44	19 38	19 31	19 24	19 16	19 08	18 58	18 47	18 34	18 19	18 01	17 38

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	14 07	14 10	14 14	14 17	14 21	14 26	14 30	14 35	14 41	14 47	14 54	15 02	15 11	15 22
25	14 42	14 44	14 47	14 49	14 52	14 55	14 58	15 02	15 05	15 10	15 15	15 20	15 26	15 34
26	15 14	15 15	15 16	15 18	15 19	15 21	15 23	15 25	15 27	15 29	15 32	15 35	15 39	15 43
27	15 44	15 44	15 45	15 45	15 45	15 46	15 46	15 46	15 47	15 47	15 48	15 49	15 49	15 50
28	16 13	16 13	16 12	16 11	16 10	16 09	16 08	16 07	16 06	16 05	16 03	16 01	16 00	15 57
29	16 43	16 41	16 40	16 38	16 36	16 34	16 31	16 28	16 26	16 22	16 19	16 15	16 10	16 05
30	17 14	17 11	17 09	17 06	17 02	16 59	16 55	16 51	16 47	16 42	16 36	16 30	16 22	16 14
31	17 47	17 43	17 40	17 36	17 31	17 27	17 22	17 16	17 10	17 03	16 56	16 47	16 37	16 24
Nov. 1	18 22	18 18	18 14	18 09	18 04	17 58	17 52	17 45	17 38	17 29	17 19	17 08	16 55	16 39
2	19 02	18 57	18 52	18 46	18 40	18 34	18 27	18 19	18 10	18 00	17 49	17 35	17 19	17 00
3	19 45	19 40	19 34	19 28	19 22	19 15	19 07	18 59	18 49	18 38	18 26	18 11	17 53	17 31
4	20 32	20 27	20 22	20 16	20 09	20 02	19 54	19 46	19 36	19 25	19 12	18 56	18 38	18 15
5	21 24	21 19	21 14	21 08	21 02	20 55	20 48	20 40	20 30	20 20	20 07	19 53	19 36	19 14
6	22 20	22 16	22 11	22 06	22 01	21 55	21 48	21 41	21 32	21 23	21 12	21 00	20 45	20 27
7	23 20	23 16	23 12	23 08	23 04	22 59	22 53	22 47	22 41	22 33	22 24	22 14	22 03	21 49
8	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 59	23 54	23 48	23 42	23 35	23 27	23 17
9	0 23	0 20	0 17	0 14	0 11	0 07	0 03	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
10	1 28	1 27	1 25	1 23	1 21	1 19	1 17	1 14	1 11	1 08	1 05	1 01	0 56	0 50
11	2 36	2 36	2 36	2 35	2 35	2 34	2 34	2 33	2 32	2 32	2 31	2 30	2 29	2 27
12	3 47	3 48	3 49	3 50	3 51	3 52	3 53	3 55	3 56	3 58	4 00	4 02	4 05	4 08
13	5 00	5 02	5 04	5 07	5 09	5 12	5 15	5 19	5 23	5 27	5 32	5 37	5 44	5 51
14	6 14	6 17	6 21	6 24	6 29	6 33	6 38	6 44	6 50	6 56	7 04	7 13	7 23	7 36
15	7 27	7 31	7 36	7 41	7 46	7 52	7 59	8 06	8 14	8 23	8 33	8 46	9 00	9 17
16	8 37	8 42	8 47	8 53	8 59	9 06	9 13	9 22	9 31	9 42	9 54	10 09	10 26	10 48
17	9 41	9 46	9 51	9 57	10 04	10 11	10 19	10 27	10 37	10 48	11 01	11 16	11 35	11 58

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	22 04	21 42	21 25	21 11	21 00	20 50	20 32	20 17	20 03	19 48	19 33	19 16	19 06	18 55
17	23 03	22 42	22 25	22 12	22 00	21 50	21 32	21 17	21 03	20 49	20 33	20 16	20 06	19 54
18	23 51	23 32	23 16	23 04	22 53	22 44	22 28	22 14	22 00	21 47	21 33	21 17	21 08	20 57
19	.. ..	.. ..	23 59	23 49	23 40	23 32	23 18	23 06	22 55	22 43	22 31	22 17	22 09	22 00
20	0 28	0 12	.. ..	.. ..	.. ..	.. ..	.. ..	23 54	23 45	23 36	23 27	23 16	23 09	23 02
21	0 58	0 46	0 36	0 28	0 21	0 15	0 04	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
22	1 23	1 15	1 08	1 02	0 58	0 53	0 46	0 39	0 33	0 27	0 20	0 12	0 08	0 03
23	1 45	1 41	1 37	1 34	1 31	1 29	1 25	1 21	1 18	1 15	1 11	1 07	1 05	1 02
24	2 05	2 05	2 04	2 04	2 03	2 03	2 02	2 02	2 01	2 01	2 01	2 00	2 00	1 59
25	2 25	2 28	2 31	2 33	2 35	2 36	2 39	2 42	2 44	2 47	2 49	2 52	2 54	2 56
26	2 45	2 52	2 58	3 02	3 06	3 10	3 16	3 22	3 27	3 32	3 38	3 44	3 48	3 52
27	3 07	3 18	3 26	3 33	3 39	3 45	3 54	4 02	4 10	4 18	4 26	4 36	4 41	4 48
28	3 32	3 46	3 57	4 06	4 14	4 21	4 33	4 44	4 54	5 04	5 15	5 28	5 35	5 43
29	4 00	4 17	4 31	4 42	4 52	5 00	5 15	5 28	5 40	5 52	6 05	6 20	6 28	6 38
30	4 34	4 54	5 09	5 22	5 33	5 42	5 59	6 13	6 27	6 40	6 55	7 11	7 21	7 32
Dec. 1	5 15	5 36	5 53	6 06	6 18	6 28	6 45	7 00	7 15	7 29	7 44	8 02	8 12	8 23
2	6 03	6 25	6 41	6 55	7 06	7 17	7 34	7 49	8 03	8 18	8 33	8 50	9 01	9 12
3	6 59	7 19	7 35	7 48	7 59	8 08	8 25	8 39	8 53	9 06	9 21	9 37	9 47	9 58
4	8 01	8 19	8 33	8 44	8 54	9 02	9 17	9 30	9 42	9 54	10 07	10 21	10 30	10 39
5	9 08	9 23	9 34	9 43	9 51	9 58	10 10	10 21	10 31	10 41	10 51	11 03	11 10	11 18
6	10 20	10 30	10 38	10 45	10 51	10 56	11 05	11 13	11 20	11 27	11 35	11 44	11 49	11 54
7	11 34	11 40	11 45	11 49	11 52	11 55	12 00	12 05	12 09	12 13	12 18	12 23	12 26	12 29
8	12 51	12 53	12 54	12 54	12 55	12 56	12 57	12 58	12 59	13 00	13 01	13 02	13 03	13 03
9	14 11	14 08	14 05	14 02	14 00	13 59	13 55	13 53	13 50	13 48	13 45	13 42	13 40	13 39
10	15 34	15 25	15 18	15 13	15 08	15 04	14 56	14 50	14 44	14 38	14 32	14 25	14 21	14 16

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	5 35	5 55	6 11	6 24	6 35	6 45	7 02	7 17	7 30	7 44	7 59	8 16	8 26	8 37
17	6 30	6 51	7 08	7 22	7 34	7 44	8 02	8 17	8 32	8 46	9 01	9 19	9 29	9 41
18	7 33	7 54	8 10	8 24	8 35	8 45	9 02	9 17	9 31	9 45	9 59	10 16	10 26	10 37
19	8 42	9 00	9 15	9 27	9 37	9 46	10 01	10 14	10 27	10 39	10 52	11 07	11 16	11 26
20	9 53	10 08	10 20	10 30	10 38	10 46	10 58	11 09	11 19	11 29	11 40	11 53	12 00	12 08
21	11 05	11 16	11 24	11 32	11 38	11 43	11 53	12 01	12 08	12 16	12 24	12 33	12 38	12 44
22	12 15	12 21	12 27	12 31	12 35	12 39	12 45	12 50	12 55	13 00	13 05	13 10	13 14	13 17
23	13 23	13 26	13 28	13 30	13 31	13 33	13 35	13 37	13 39	13 41	13 43	13 45	13 47	13 48
24	14 30	14 29	14 28	14 27	14 26	14 25	14 24	14 23	14 22	14 21	14 20	14 19	14 18	14 17
25	15 36	15 31	15 27	15 23	15 20	15 17	15 13	15 09	15 05	15 01	14 57	14 52	14 50	14 47
26	16 42	16 32	16 25	16 19	16 14	16 09	16 01	15 54	15 48	15 41	15 34	15 26	15 22	15 17
27	17 46	17 33	17 23	17 15	17 07	17 01	16 50	16 40	16 31	16 22	16 13	16 02	15 55	15 48
28	18 50	18 33	18 20	18 10	18 01	17 53	17 39	17 27	17 16	17 05	16 53	16 40	16 32	16 23
29	19 50	19 31	19 16	19 04	18 54	18 45	18 29	18 15	18 02	17 49	17 36	17 20	17 11	17 01
30	20 47	20 27	20 10	19 57	19 45	19 36	19 18	19 04	18 50	18 36	18 21	18 04	17 54	17 43
Dec. 1	21 39	21 17	21 01	20 47	20 35	20 25	20 08	19 52	19 38	19 24	19 08	18 51	18 41	18 29
2	22 24	22 03	21 47	21 34	21 23	21 13	20 56	20 41	20 27	20 13	19 58	19 41	19 31	19 20
3	23 03	22 44	22 30	22 18	22 07	21 58	21 43	21 29	21 16	21 04	20 50	20 34	20 25	20 14
4	23 35	23 20	23 08	22 58	22 49	22 41	22 28	22 16	22 05	21 54	21 43	21 29	21 21	21 12
5	.. ..	23 52	23 43	23 35	23 28	23 22	23 12	23 03	22 54	22 46	22 36	22 26	22 20	22 12
6	0 04	.. ..	.. ..	.. ..	.. ..	.. ..	23 55	23 49	23 43	23 37	23 31	23 24	23 20	23 15
7	0 29	0 22	0 16	0 10	0 06	0 02	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
8	0 53	0 50	0 47	0 45	0 43	0 41	0 38	0 35	0 33	0 30	0 27	0 24	0 22	0 20
9	1 16	1 18	1 18	1 19	1 20	1 20	1 21	1 22	1 23	1 24	1 25	1 25	1 26	1 27
10	1 41	1 47	1 51	1 55	1 59	2 01	2 07	2 11	2 15	2 20	2 24	2 29	2 32	2 36

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

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Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	18 55	18 50	18 44	18 38	18 32	18 25	18 17	18 09	17 59	17 48	17 36	17 21	17 03	16 42
17	19 54	19 49	19 44	19 38	19 31	19 24	19 16	19 08	18 58	18 47	18 34	18 19	18 01	17 38
18	20 57	20 52	20 47	20 41	20 35	20 29	20 22	20 14	20 05	19 55	19 43	19 29	19 13	18 52
19	22 00	21 56	21 52	21 47	21 42	21 36	21 30	21 23	21 16	21 07	20 58	20 46	20 33	20 17
20	23 02	22 59	22 56	22 52	22 48	22 44	22 39	22 34	22 28	22 22	22 14	22 06	21 56	21 44
21	.. ..	.. ..	23 58	23 56	23 53	23 50	23 47	23 43	23 39	23 35	23 30	23 24	23 18	23 10
22	0 03	0 01	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
23	1 02	1 01	0 59	0 58	0 57	0 55	0 53	0 51	0 49	0 47	0 44	0 42	0 38	0 34
24	1 59	1 59	1 59	1 59	1 59	1 59	1 58	1 58	1 58	1 58	1 57	1 57	1 57	1 56
25	2 56	2 57	2 58	2 59	3 00	3 01	3 02	3 04	3 05	3 07	3 09	3 11	3 14	3 17
26	3 52	3 54	3 56	3 58	4 00	4 03	4 06	4 09	4 12	4 16	4 20	4 25	4 30	4 36
27	4 48	4 51	4 54	4 57	5 00	5 04	5 08	5 13	5 18	5 24	5 30	5 37	5 46	5 56
28	5 43	5 47	5 51	5 55	6 00	6 05	6 10	6 16	6 23	6 31	6 39	6 49	7 01	7 15
29	6 38	6 43	6 47	6 52	6 58	7 04	7 11	7 18	7 26	7 35	7 46	7 58	8 13	8 31
30	7 32	7 37	7 42	7 48	7 54	8 01	8 08	8 17	8 26	8 36	8 49	9 03	9 20	9 42
Dec. 1	8 23	8 29	8 34	8 40	8 47	8 54	9 02	9 11	9 21	9 32	9 45	10 00	10 19	10 43
2	9 12	9 17	9 23	9 29	9 35	9 43	9 50	9 59	10 09	10 20	10 33	10 48	11 07	11 30
3	9 58	10 02	10 08	10 13	10 19	10 26	10 33	10 41	10 50	11 01	11 12	11 26	11 43	12 03
4	10 39	10 44	10 48	10 53	10 58	11 04	11 11	11 18	11 25	11 34	11 44	11 56	12 09	12 26
5	11 18	11 22	11 25	11 29	11 34	11 38	11 43	11 49	11 55	12 02	12 10	12 19	12 29	12 42
6	11 54	11 57	12 00	12 02	12 06	12 09	12 13	12 17	12 21	12 26	12 31	12 38	12 45	12 53
7	12 29	12 31	12 32	12 34	12 36	12 38	12 40	12 42	12 45	12 47	12 51	12 54	12 58	13 03
8	13 03	13 04	13 04	13 05	13 05	13 05	13 06	13 06	13 07	13 08	13 08	13 09	13 10	13 11
9	13 39	13 38	13 37	13 36	13 35	13 34	13 33	13 31	13 30	13 28	13 27	13 25	13 23	13 20
10	14 16	14 14	14 12	14 10	14 07	14 04	14 02	13 58	13 55	13 51	13 47	13 42	13 36	13 30

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	8 37	8 42	8 47	8 53	8 59	9 06	9 13	9 22	9 31	9 42	9 54	10 09	10 26	10 48
17	9 41	9 46	9 51	9 57	10 04	10 11	10 19	10 27	10 37	10 48	11 01	11 16	11 35	11 58
18	10 37	10 42	10 47	10 53	10 59	11 06	11 13	11 21	11 31	11 41	11 53	12 07	12 24	12 44
19	11 26	11 30	11 35	11 40	11 45	11 51	11 57	12 04	12 12	12 21	12 32	12 43	12 57	13 14
20	12 08	12 11	12 15	12 19	12 23	12 28	12 33	12 39	12 45	12 52	13 00	13 09	13 20	13 33
21	12 44	12 47	12 50	12 53	12 56	12 59	13 03	13 07	13 12	13 17	13 23	13 29	13 37	13 45
22	13 17	13 19	13 21	13 23	13 25	13 27	13 29	13 32	13 34	13 38	13 41	13 45	13 49	13 55
23	13 48	13 49	13 49	13 50	13 51	13 52	13 53	13 54	13 55	13 56	13 57	13 59	14 00	14 02
24	14 17	14 17	14 17	14 16	14 16	14 15	14 15	14 14	14 14	14 13	14 12	14 11	14 10	14 09
25	14 47	14 45	14 44	14 42	14 41	14 39	14 37	14 35	14 33	14 30	14 27	14 24	14 20	14 16
26	15 17	15 14	15 12	15 09	15 07	15 04	15 00	14 57	14 53	14 48	14 43	14 38	14 31	14 24
27	15 48	15 45	15 42	15 38	15 34	15 30	15 26	15 20	15 15	15 09	15 02	14 54	14 44	14 33
28	16 23	16 19	16 15	16 10	16 05	16 00	15 54	15 48	15 40	15 32	15 23	15 13	15 01	14 46
29	17 01	16 56	16 51	16 46	16 40	16 34	16 27	16 19	16 11	16 01	15 50	15 38	15 22	15 04
30	17 43	17 38	17 32	17 26	17 20	17 13	17 05	16 57	16 47	16 37	16 24	16 10	15 52	15 30
Dec. 1	18 29	18 24	18 18	18 12	18 05	17 58	17 50	17 41	17 32	17 20	17 07	16 52	16 33	16 09
2	19 20	19 14	19 09	19 03	18 57	18 50	18 42	18 33	18 23	18 12	18 00	17 45	17 26	17 03
3	20 14	20 09	20 04	19 59	19 53	19 47	19 40	19 32	19 23	19 13	19 01	18 48	18 32	18 12
4	21 12	21 08	21 04	20 59	20 54	20 49	20 43	20 36	20 29	20 20	20 11	20 00	19 47	19 31
5	22 12	22 09	22 06	22 02	21 59	21 54	21 50	21 45	21 39	21 33	21 25	21 17	21 07	20 56
6	23 15	23 13	23 11	23 08	23 06	23 03	23 00	22 57	22 53	22 49	22 44	22 39	22 32	22 25
7	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 57
8	0 20	0 19	0 18	0 17	0 15	0 14	0 13	0 11	0 10	0 08	0 06	0 03	0 00	.. ..
9	1 27	1 27	1 27	1 27	1 28	1 28	1 28	1 29	1 29	1 30	1 30	1 31	1 31	1 32
10	2 36	2 37	2 39	2 40	2 42	2 44	2 46	2 49	2 51	2 54	2 58	3 01	3 06	3 10

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	14 11	14 08	14 05	14 02	14 00	13 59	13 55	13 53	13 50	13 48	13 45	13 42	13 40	13 39
10	15 34	15 25	15 18	15 13	15 08	15 04	14 56	14 50	14 44	14 38	14 32	14 25	14 21	14 16
11	16 58	16 44	16 34	16 25	16 17	16 11	15 59	15 49	15 40	15 31	15 21	15 10	15 04	14 57
12	18 20	18 03	17 49	17 37	17 27	17 19	17 04	16 51	16 39	16 27	16 15	16 01	15 52	15 43
13	19 38	19 17	19 01	18 47	18 36	18 26	18 09	17 54	17 41	17 27	17 12	16 56	16 46	16 35
14	20 46	20 24	20 07	19 53	19 41	19 30	19 13	18 57	18 43	18 28	18 13	17 55	17 45	17 33
15	21 41	21 21	21 04	20 51	20 39	20 29	20 12	19 57	19 43	19 29	19 14	18 57	18 47	18 36
16	22 25	22 07	21 53	21 41	21 31	21 22	21 07	20 54	20 41	20 29	20 15	20 00	19 51	19 41
17	23 00	22 46	22 34	22 25	22 16	22 09	21 57	21 46	21 35	21 25	21 14	21 02	20 54	20 46
18	23 28	23 17	23 09	23 02	22 56	22 51	22 42	22 34	22 26	22 19	22 10	22 01	21 56	21 50
19	23 51	23 45	23 40	23 36	23 32	23 29	23 23	23 18	23 14	23 09	23 04	22 58	22 55	22 51
20	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 59	23 57	23 55	23 53	23 52	23 50
21	0 12	0 10	0 08	0 07	0 05	0 04	0 02	0 00	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
22	0 32	0 34	0 35	0 36	0 37	0 38	0 39	0 41	0 42	0 43	0 45	0 46	0 47	0 48
23	0 52	0 58	1 02	1 06	1 09	1 12	1 16	1 21	1 25	1 29	1 33	1 38	1 41	1 45
24	1 13	1 22	1 30	1 36	1 41	1 46	1 54	2 01	2 08	2 15	2 22	2 30	2 35	2 41
25	1 36	1 49	1 59	2 08	2 15	2 21	2 32	2 42	2 51	3 01	3 11	3 22	3 29	3 36
26	2 03	2 19	2 32	2 42	2 51	2 59	3 13	3 25	3 36	3 48	4 00	4 14	4 22	4 31
27	2 35	2 54	3 08	3 21	3 31	3 40	3 56	4 10	4 23	4 36	4 50	5 06	5 15	5 26
28	3 13	3 34	3 50	4 03	4 15	4 25	4 42	4 57	5 11	5 25	5 40	5 57	6 07	6 19
29	3 59	4 20	4 37	4 51	5 02	5 12	5 30	5 45	6 00	6 14	6 29	6 47	6 57	7 09
30	4 52	5 13	5 29	5 42	5 54	6 04	6 21	6 36	6 49	7 03	7 18	7 35	7 45	7 56
31	5 53	6 11	6 26	6 38	6 49	6 58	7 13	7 27	7 39	7 52	8 06	8 21	8 30	8 40
32	6 59	7 15	7 27	7 37	7 46	7 54	8 07	8 18	8 29	8 40	8 51	9 04	9 12	9 20
33	8 10	8 21	8 31	8 38	8 45	8 51	9 01	9 10	9 18	9 26	9 35	9 45	9 51	9 57

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	1 16	1 18	1 18	1 19	1 20	1 20	1 21	1 22	1 23	1 24	1 25	1 25	1 26	1 27
10	1 41	1 47	1 51	1 55	1 59	2 01	2 07	2 11	2 15	2 20	2 24	2 29	2 32	2 36
11	2 08	2 19	2 27	2 34	2 40	2 45	2 55	3 03	3 10	3 18	3 26	3 35	3 41	3 47
12	2 41	2 56	3 07	3 17	3 26	3 33	3 46	3 57	4 08	4 19	4 30	4 43	4 50	4 59
13	3 20	3 39	3 54	4 06	4 17	4 26	4 42	4 55	5 08	5 21	5 35	5 51	6 00	6 11
14	4 10	4 31	4 48	5 01	5 13	5 23	5 41	5 56	6 10	6 24	6 40	6 57	7 07	7 19
15	5 09	5 31	5 48	6 02	6 14	6 24	6 42	6 57	7 12	7 26	7 41	7 59	8 09	8 21
16	6 17	6 38	6 53	7 06	7 17	7 27	7 44	7 58	8 11	8 25	8 39	8 55	9 04	9 15
17	7 30	7 47	8 01	8 12	8 21	8 30	8 44	8 56	9 08	9 19	9 31	9 45	9 53	10 02
18	8 45	8 58	9 08	9 17	9 24	9 30	9 41	9 51	10 00	10 09	10 19	10 29	10 36	10 43
19	9 58	10 06	10 13	10 19	10 24	10 29	10 36	10 43	10 49	10 55	11 02	11 09	11 13	11 18
20	11 09	11 13	11 17	11 20	11 22	11 25	11 29	11 32	11 35	11 39	11 42	11 46	11 48	11 50
21	12 17	12 18	12 18	12 18	12 19	12 19	12 19	12 19	12 20	12 20	12 20	12 20	12 20	12 20
22	13 25	13 21	13 18	13 15	13 13	13 11	13 08	13 05	13 03	13 00	12 57	12 54	12 52	12 50
23	14 31	14 23	14 17	14 12	14 07	14 04	13 57	13 51	13 45	13 40	13 34	13 28	13 24	13 19
24	15 36	15 24	15 15	15 07	15 01	14 55	14 45	14 37	14 29	14 21	14 12	14 02	13 57	13 50
25	16 40	16 25	16 13	16 03	15 54	15 47	15 34	15 23	15 13	15 03	14 52	14 39	14 32	14 24
26	17 42	17 24	17 09	16 58	16 48	16 39	16 24	16 11	15 59	15 46	15 33	15 18	15 10	15 00
27	18 41	18 20	18 04	17 51	17 40	17 31	17 14	16 59	16 46	16 32	16 18	16 01	15 51	15 40
28	19 35	19 14	18 57	18 43	18 31	18 21	18 04	17 48	17 34	17 20	17 05	16 47	16 37	16 25
29	20 23	20 02	19 46	19*32	19 20	19 10	18 53	18 38	18 24	18 09	17 54	17 37	17 26	17 15
30	21 05	20 45	20 30	20 17	20 07	19 57	19 41	19 27	19 13	19 00	18 46	18 29	18 20	18 09
31	21 40	21 23	21 10	20 59	20 50	20 42	20 28	20 15	20 03	19 51	19 39	19 24	19 16	19 06
32	22 10	21 57	21 47	21 38	21 30	21 24	21 12	21 02	20 53	20 43	20 33	20 21	20 14	20 06
33	22 36	22 27	22 20	22 14	22 08	22 04	21 56	21 48	21 41	21 35	21 27	21 19	21 14	21 08

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2016

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

63

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	13 39	13 38	13 37	13 36	13 35	13 34	13 33	13 31	13 30	13 28	13 27	13 25	13 23	13 20
10	14 16	14 14	14 12	14 10	14 07	14 04	14 02	13 58	13 55	13 51	13 47	13 42	13 36	13 30
11	14 57	14 54	14 50	14 47	14 43	14 39	14 34	14 29	14 24	14 17	14 11	14 03	13 54	13 43
12	15 43	15 39	15 34	15 30	15 24	15 19	15 13	15 06	14 59	14 50	14 41	14 30	14 17	14 01
13	16 35	16 30	16 25	16 19	16 13	16 07	15 59	15 51	15 42	15 32	15 20	15 06	14 50	14 30
14	17 33	17 28	17 22	17 16	17 10	17 03	16 55	16 46	16 36	16 25	16 12	15 57	15 38	15 15
15	18 36	18 31	18 25	18 19	18 13	18 06	17 58	17 50	17 40	17 29	17 17	17 02	16 44	16 22
16	19 41	19 36	19 32	19 26	19 21	19 14	19 08	19 00	18 52	18 42	18 31	18 18	18 03	17 44
17	20 46	20 42	20 38	20 34	20 30	20 25	20 19	20 13	20 06	19 59	19 50	19 40	19 28	19 14
18	21 50	21 47	21 44	21 41	21 38	21 34	21 30	21 26	21 21	21 15	21 09	21 02	20 54	20 45
19	22 51	22 49	22 48	22 46	22 44	22 42	22 39	22 37	22 34	22 30	22 27	22 23	22 18	22 12
20	23 50	23 50	23 49	23 49	23 48	23 47	23 46	23 45	23 44	23 43	23 42	23 40	23 39	23 37
21	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
22	0 48	0 49	0 49	0 50	0 50	0 51	0 51	0 52	0 53	0 54	0 55	0 56	0 57	0 59
23	1 45	1 46	1 48	1 49	1 51	1 53	1 55	1 58	2 00	2 03	2 07	2 10	2 15	2 20
24	2 41	2 43	2 46	2 49	2 52	2 55	2 58	3 02	3 07	3 12	3 17	3 24	3 31	3 39
25	3 36	3 40	3 43	3 47	3 51	3 56	4 01	4 06	4 12	4 19	4 27	4 36	4 46	4 59
26	4 31	4 36	4 40	4 45	4 50	4 56	5 02	5 09	5 16	5 25	5 35	5 46	6 00	6 16
27	5 26	5 31	5 36	5 41	5 47	5 54	6 01	6 09	6 18	6 28	6 40	6 53	7 10	7 30
28	6 19	6 24	6 29	6 35	6 42	6 49	6 57	7 05	7 15	7 26	7 39	7 54	8 13	8 36
29	7 09	7 14	7 20	7 26	7 33	7 40	7 48	7 57	8 07	8 18	8 31	8 47	9 06	9 29
30	7 56	8 01	8 07	8 13	8 19	8 26	8 33	8 42	8 51	9 02	9 14	9 29	9 46	10 08
31	8 40	8 45	8 49	8 55	9 00	9 07	9 13	9 21	9 29	9 38	9 49	10 02	10 16	10 34
32	9 20	9 24	9 28	9 32	9 37	9 42	9 48	9 54	10 01	10 08	10 17	10 27	10 39	10 52
33	9 57	10 00	10 03	10 07	10 10	10 14	10 18	10 23	10 28	10 34	10 40	10 47	10 56	11 05

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	1 27	1 27	1 27	1 27	1 28	1 28	1 28	1 29	1 29	1 30	1 30	1 31	1 31	1 32
10	2 36	2 37	2 39	2 40	2 42	2 44	2 46	2 49	2 51	2 54	2 58	3 01	3 06	3 10
11	3 47	3 49	3 52	3 55	3 59	4 02	4 06	4 11	4 16	4 21	4 27	4 34	4 42	4 52
12	4 59	5 03	5 07	5 11	5 16	5 21	5 27	5 33	5 40	5 48	5 57	6 07	6 20	6 34
13	6 11	6 15	6 20	6 26	6 32	6 38	6 45	6 53	7 02	7 12	7 23	7 36	7 52	8 12
14	7 19	7 24	7 29	7 35	7 42	7 49	7 57	8 05	8 15	8 26	8 39	8 54	9 13	9 36
15	8 21	8 26	8 31	8 37	8 44	8 51	8 59	9 07	9 17	9 28	9 41	9 56	10 14	10 37
16	9 15	9 20	9 25	9 30	9 36	9 43	9 50	9 58	10 06	10 16	10 28	10 41	10 57	11 16
17	10 02	10 06	10 10	10 15	10 20	10 25	10 31	10 38	10 45	10 53	11 02	11 13	11 25	11 40
18	10 43	10 46	10 49	10 52	10 56	11 00	11 05	11 10	11 15	11 21	11 28	11 36	11 45	11 55
19	11 18	11 20	11 22	11 25	11 27	11 30	11 33	11 36	11 40	11 44	11 49	11 54	12 00	12 06
20	11 50	11 51	11 53	11 54	11 55	11 56	11 58	12 00	12 02	12 04	12 06	12 08	12 11	12 15
21	12 20	12 21	12 21	12 21	12 21	12 21	12 21	12 21	12 21	12 21	12 21	12 21	12 22	12 22
22	12 50	12 49	12 48	12 47	12 46	12 44	12 43	12 42	12 40	12 38	12 36	12 34	12 31	12 29
23	13 19	13 18	13 16	13 13	13 11	13 09	13 06	13 03	13 00	12 56	12 52	12 47	12 42	12 36
24	13 50	13 48	13 45	13 41	13 38	13 34	13 30	13 26	13 21	13 15	13 09	13 02	12 54	12 44
25	14 24	14 20	14 16	14 12	14 07	14 02	13 57	13 51	13 45	13 37	13 29	13 19	13 08	12 55
26	15 00	14 55	14 51	14 46	14 40	14 34	14 28	14 21	14 13	14 04	13 53	13 41	13 27	13 10
27	15 40	15 35	15 30	15 24	15 18	15 11	15 04	14 56	14 47	14 36	14 24	14 10	13 54	13 33
28	16 25	16 20	16 14	16 08	16 02	15 55	15 47	15 38	15 28	15 17	15 04	14 48	14 30	14 06
29	17 15	17 10	17 04	16 58	16 51	16 44	16 36	16 27	16 17	16 06	15 53	15 38	15 19	14 55
30	18 09	18 04	17 59	17 53	17 47	17 40	17 33	17 24	17 15	17 04	16 52	16 38	16 21	16 00
31	19 06	19 02	18 57	18 52	18 47	18 41	18 35	18 27	18 19	18 10	18 00	17 48	17 34	17 16
32	20 06	20 03	19 59	19 55	19 51	19 46	19 41	19 35	19 29	19 22	19 14	19 04	18 53	18 40
33	21 08	21 06	21 03	21 00	20 57	20 54	20 50	20 46	20 42	20 37	20 31	20 25	20 17	20 09

.. .. indicates phenomenon will occur the next day.

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SUMMARY OF ECLIPSES AND TRANSITS FOR 2016

There are five eclipses, two of the Sun and three of the Moon. All times are expressed in Universal Time using $\Delta T = +68^s.0$. There is a transit of Mercury across the Sun.

I. *A total eclipse of the Sun*, March 8-9. See map on page 71. The eclipse begins at 23^h 19^m on March 8 and ends at 04^h 35^m on March 9. Maximum duration of totality is 04^m 14^s. It is visible from southern Asia, Oceania, Australia, extreme northwestern North America, the Indian Ocean, and the northern Pacific Ocean.

II. *A penumbral eclipse of the Moon*, March 23. See map on page 75. The eclipse begins at 09^h 37^m and ends at 13^h 57^m. It is visible from Asia, Australia, Oceania, North America, western South America, Antarctica, the eastern Indian Ocean and the Pacific Ocean.

III. *A penumbral eclipse of the Moon*, August 18. See map on page 76. The eclipse begins at 09^h 24^m and ends at 10^h 01^m. It is visible from northeastern Asia, Australia, Oceania, North America, western South America, Antarctica, and the Pacific Ocean.

IV. *An annular eclipse of the Sun*, September 1. See map on page 78. The eclipse begins at 06^h 13^m and ends at 12^h 01^m. Maximum duration of annularity is 03^m 00^s. It is visible from Africa, southwestern Middle East, Antarctica, the Atlantic Ocean, and the Indian Ocean.

V. *A penumbral eclipse of the Moon*, September 16. See map on page 82. The eclipse begins at 16^h 53^m and ends at 20^h 56^m. It is visible from extreme eastern South America, Europe, Asia, Africa, Antarctica, Australia, Oceania, the eastern Atlantic Ocean, the Indian Ocean, and the western Pacific Ocean.

Transit of Mercury. A transit of Mercury over the disk of the Sun will occur on May 9. The entire transit will be visible in eastern North America, northern South America, the Arctic, Greenland, extreme northwestern Africa, western Europe, and the Atlantic Ocean.

Local circumstances and animations for upcoming eclipses can be found on *The Astronomical Almanac Online* at <http://asa.hmnao.com> or <http://asa.usno.navy.mil>.

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General Information

The elements and circumstances are computed according to Bessel's method from apparent right ascensions and declinations of the Sun and Moon. Semidiameters of the Sun and Moon used in the calculation of eclipses do not include irradiation. The adopted semidiameter of the Sun at unit distance is $15' 59''.64$ from the IAU (1976) Astronomical Constants. The apparent semidiameter of the Moon is equal to $\arcsin(k \sin \pi)$, where π is the Moon's horizontal parallax and k is an adopted constant. In 1982, the IAU adopted $k = 0.272\,5076$, corresponding to the mean radius of Watts' datum as determined by observations of occultations and to the adopted radius of the Earth.

Standard corrections of $+0''.5$ and $-0''.25$ have been applied to the longitude and latitude of the Moon, respectively, to help correct for the difference between the center of figure and the center of mass.

Refraction is neglected in calculating solar and lunar eclipses. Because the circumstances of eclipses are calculated for the surface of the ellipsoid, refraction is not included in Besselian element polynomials. For local predictions, corrections for refraction are unnecessary; they are required only in precise comparisons of theory with observation in which many other refinements are also necessary.

All time arguments are given provisionally in Universal Time, using $\Delta T(A) = +68^s.0$. Once an updated value of ΔT is known, the data on these pages may be expressed in Universal Time as follows:

Define $\delta T = \Delta T - \Delta T(A)$, in units of seconds of time.

Change the times of circumstances given in preliminary Universal Time by subtracting δT .

Correct the tabulated longitudes, $\lambda(A)$, using $\lambda = \lambda(A) + 0.00417807 \times \delta T$ (longitudes are in degrees).

Leave all other quantities unchanged.

The correction of δT is included in the Besselian elements.

Longitude is positive to the east, and negative to the west.

Explanation of Solar Eclipse Diagram

The solar eclipse diagrams in *The Astronomical Almanac* show the region over which different phases of each eclipse may be seen and the times at which these phases occur. Each diagram has a series of dashed curves that show the outline of the Moon's penumbra on the Earth's surface at one-hour intervals. Short dashes show the leading edge and long dashes show the trailing edge. Except for certain extreme cases, the shadow outline moves generally from west to east. The Moon's shadow cone first contacts the Earth's surface where "First Contact" is indicated on the diagram. "Last Contact" is where the Moon's shadow cone last contacts the Earth's surface. The path of the central eclipse, whether for a total, annular, or annular-total eclipse, is marked by two closely spaced curves that cut across all of the dashed curves. These two curves mark the extent of the Moon's umbral shadow on the Earth's surface. Viewers within these boundaries will observe a total, annular, or annular-total eclipse and viewers outside these boundaries will see a partial eclipse.

Solid curves labeled "Northern" and "Southern Limit of Eclipse" represent the furthest extent north or south of the Moon's penumbra on the Earth's surface. Viewers outside of

these boundaries will not experience any eclipse. When only one of these two curves appears, only part of the Moon's penumbra touches the Earth; the other part is projected into space north or south of the Earth, and the terminator defines the other limit.

Another set of solid curves appears on some diagrams as two teardrop shapes (or lobes) on either end of the eclipse path, and on other diagrams as a distorted figure eight. These lobes represent in time the intersection of the Moon's penumbra with the Earth's terminator as the eclipse progresses. As time elapses, the Earth's terminator moves east-to-west while the Moon's penumbra moves west-to-east. These lobes connect to form an elongated figure eight on a diagram when part of the Moon's penumbra stays in contact with the Earth's terminator throughout the eclipse. The lobes become two separate teardrop shapes when the Moon's penumbra breaks contact with the Earth's terminator during the beginning of the eclipse and reconnects with it near the end. In the east, the outer portion of the lobe is labeled "Eclipse begins at Sunset" and marks the first contact between the Moon's penumbra and Earth's terminator in the east. Observers on this curve just fail to see the eclipse. The inner part of the lobe is labeled "Eclipse ends at Sunset" and marks the last contact between the Moon's penumbra and the Earth's terminator in the east. Observers on this curve just see the whole eclipse. The curve bisecting this lobe is labeled "Maximum Eclipse at Sunset" and is part of the sunset terminator at maximum eclipse. Viewers in the eastern half of the lobe will see the Sun set before maximum eclipse; *i.e.* see less than half of the eclipse. Viewers in the western half of the lobe will see the Sun set after maximum eclipse; *i.e.* see more than half of the eclipse. A similar description holds for the western lobe except everything occurs at sunrise instead of sunset.

Computing Local Circumstances for Solar Eclipses

The solar eclipse maps show the path of the eclipse, beginning and ending times of the eclipse, and the region of visibility, including restrictions due to rising and setting of the Sun. The short-dash and long-dash lines show, respectively, the progress of the leading and trailing edge of the penumbra; thus, at a given location, the times of the first and last contact may be interpolated. If further precision is desired, Besselian elements can be utilized.

Besselian elements characterize the geometric position of the shadow of the Moon relative to the Earth. The exterior tangents to the surfaces of the Sun and Moon form the umbral cone; the interior tangents form the penumbral cone. The common axis of these two cones is the axis of the shadow. To form a system of geocentric rectangular coordinates, the geocentric plane perpendicular to the axis of the shadow is taken as the xy -plane. This is called the fundamental plane. The x -axis is the intersection of the fundamental plane with the plane of the equator; it is positive toward the east. The y -axis is positive toward the north. The z -axis is parallel to the axis of the shadow and is positive toward the Moon. The tabular values of x and y are the coordinates, in units of the Earth's equatorial radius, of the intersection of the axis of the shadow with the fundamental plane. The direction of the axis of the shadow is specified by the declination d and hour angle μ of the point on the celestial sphere toward which the axis is directed.

The radius of the umbral cone is regarded as positive for an annular eclipse and negative for a total eclipse. The angles f_1 and f_2 are the angles at which the tangents that form the penumbral and umbral cones, respectively, intersect the axis of the shadow.

To predict accurate local circumstances, calculate the geocentric coordinates $\rho \sin \phi'$ and $\rho \cos \phi'$ from the geodetic latitude ϕ and longitude λ , using the relationships given on pages K11–K12 of *The Astronomical Almanac*. Inclusion of the height h in this calculation is all that is necessary to obtain the local circumstances at high altitudes.

Obtain approximate times for the beginning, middle and end of the eclipse from the eclipse map. For each of these three times compute from the Besselian element polynomials, the values of x , y , $\sin d$, $\cos d$, μ and l_1 (the radius of the penumbra on the fundamental plane), except that at the approximate time of the middle of the eclipse l_2 (the radius of the umbra on the fundamental plane) is required instead of l_1 if the eclipse is central (i.e., total, annular or annular-total). The hourly variations x' , y' of x and y are needed, and may be obtained by evaluating the derivative of the polynomial expressions for x and y . Values of μ' , d' , $\tan f_1$ and $\tan f_2$ are nearly constant throughout the eclipse and are given immediately following the Besselian polynomials.

For each of the three approximate times, calculate the coordinates ξ , η , ζ for the observer and the hourly variations ξ' and η' from

$$\begin{aligned}\xi &= \rho \cos \phi' \sin \theta, \\ \eta &= \rho \sin \phi' \cos d - \rho \cos \phi' \sin d \cos \theta, \\ \zeta &= \rho \sin \phi' \sin d + \rho \cos \phi' \cos d \cos \theta, \\ \xi' &= \mu' \rho \cos \phi' \cos \theta, \\ \eta' &= \mu' \xi \sin d - \zeta d',\end{aligned}$$

where

$$\theta = \mu + \lambda$$

for longitudes measured positive towards the east.

Next, calculate

$$\begin{aligned}u &= x - \xi & u' &= x' - \xi' \\ v &= y - \eta & v' &= y' - \eta' \\ m^2 &= u^2 + v^2 & n^2 &= u'^2 + v'^2 \quad (m, n > 0) \\ L_i &= l_i - \zeta \tan f_i \\ D &= uu' + vv' \\ \Delta &= \frac{1}{n}(uv' - u'v) \\ \sin \psi &= \frac{\Delta}{L_i}\end{aligned}$$

where $i = 1, 2$.

At the approximate times of the beginning and end of the eclipse, L_1 is required. At the approximate time of the middle of the eclipse, L_2 is required if the eclipse is central; L_1 is required if the eclipse is partial.

Neglecting the variation of L , the correction τ to be applied to the approximate time of the middle of the eclipse to obtain the *Universal Time of greatest phase* is

$$\tau = -\frac{D}{n^2},$$

which may be expressed in minutes by multiplying by 60. The correction τ to be applied to the approximate times of the beginning and end of the eclipse to obtain the *Universal Times of the penumbral contacts* is

$$\tau = \frac{L_1}{n} \cos \psi - \frac{D}{n^2},$$

which may be expressed in minutes by multiplying by 60.

If the eclipse is central, use the approximate time for the middle of the eclipse as a first approximation to the times of umbral contact. The correction τ to be applied to obtain the *Universal Times of the umbral contacts* is

$$\tau = \frac{L_2}{n} \cos \psi - \frac{D}{n^2},$$

which may be expressed in minutes by multiplying by 60.

In the last two equations, the ambiguity in the quadrant of ψ is removed by noting that $\cos \psi$ must be *negative* for the beginning of the eclipse, for the beginning of the annular phase, or for the end of the total phase; $\cos \psi$ must be *positive* for the end of the eclipse, the end of the annular phase, or the beginning of the total phase.

For greater accuracy, the times resulting from the calculation outlined above should be used in place of the original approximate times, and the entire procedure repeated at least once. The calculations for each of the contact times and the time of greatest phase should be performed separately.

The *magnitude of greatest partial eclipse*, in units of the solar diameter is

$$M_1 = \frac{L_1 - m}{(2L_1 - 0.5459)},$$

where the value of m at the time of greatest phase is used. If the magnitude is negative at the time of greatest phase, no eclipse is visible from the location.

The *magnitude of the central phase*, in the same units is

$$M_2 = \frac{L_1 - L_2}{(L_1 + L_2)}.$$

The *position angle of a point of contact* measured eastward (counterclockwise) from the north point of the solar limb is given by

$$\tan P = \frac{u}{v},$$

where u and v are evaluated at the times of contacts computed in the final approximation. The quadrant of P is determined by noting that $\sin P$ has the algebraic sign of u , except for the contacts of the total phase, for which $\sin P$ has the opposite sign to u .

The position angle of the point of contact measured eastward from the vertex of the solar limb is given by

$$V = P - C,$$

where C , the parallactic angle, is obtained with sufficient accuracy from

$$\tan C = \frac{\xi}{\eta},$$

with $\sin C$ having the same algebraic sign as ξ , and the results of the final approximation again being used. The vertex point of the solar limb lies on a great circle arc drawn from the zenith to the center of the solar disk.

Lunar Eclipses

A calculator to produce local circumstances of recent and upcoming lunar eclipses is provided at <http://aa.usno.navy.mil/data/docs/LunarEclipse.php>

In calculating lunar eclipses the radius of the geocentric shadow of the Earth is increased by one-fiftieth part to allow for the effect of the atmosphere. Refraction is neglected in calculating solar and lunar eclipses. Standard corrections of $+0''.5$ and $-0''.25$ have been applied to the longitude and latitude of the Moon, respectively, to help correct for the difference between the center of figure and the center of mass.

Explanation of Lunar Eclipse Diagram

Information on lunar eclipses is presented in the form of a diagram consisting of two parts. The upper panel shows the path of the Moon relative to the penumbral and umbral shadows of the Earth. The lower panel shows the visibility of the eclipse from the surface of the Earth. The title of the upper panel includes the type of eclipse, its place in the sequence of eclipses for the year and the Greenwich calendar date of the eclipse. The inner darker circle is the umbral shadow of the Earth and the outer lighter circle is that of the penumbra. The axis of the shadow of the Earth is denoted by (+) with the ecliptic shown for reference purposes. A 30-arcminute scale bar is provided on the right hand side of the diagram and the orientation is given by the cardinal points displayed on the small graphic on the left hand side of the diagram. The position angle (PA) is measured from North point of the lunar disk along the limb of the Moon to the point of contact. It is shown on the graphic by the use of an arc extending anti-clockwise (eastwards) from North terminated with an arrow head.

Moon symbols are plotted at the principal phases of the eclipse to show its position relative to the umbral and penumbral shadows. The UT times of the different phases of the eclipse to the nearest tenth of a minute are printed above or below the Moon symbols as appropriate. P1 and P4 are the first and last external contacts of the penumbra respectively and denote the beginning and end of the penumbral eclipse respectively. U1 and U4 are the first and last external contacts of the umbra denoting the beginning and end of the partial phase of the eclipse respectively. U2 and U3 are the first and last internal contacts of the umbra and denote the beginning and end of the total phase respectively. MID is the middle of the eclipse. The position angle is given for P1 and P4 for penumbral eclipses and U1 and U4 for partial and total eclipses. The UT time of the geocentric opposition in right ascension of the Sun and Moon and the magnitude of the eclipse are given above or below the Moon symbols as appropriate.

The lower panel is a cylindrical equidistant map projection showing the Earth centered on the longitude at which the Moon is in the zenith at the middle of the eclipse. The visibility of the eclipse is displayed by plotting the Moon rise/set terminator for the principal phases of the eclipse for which timing information is provided in the upper panel. The terminator for the middle of the eclipse is not plotted for the sake of clarity.

The unshaded area indicates the region of the Earth from which all the eclipse is visible whereas the darkest shading indicates the area from which the eclipse is invisible. The different shades of gray indicate regions where the Moon is either rising or setting during the principal phases of the eclipse. The Moon is rising on the left hand side of the diagram after the eclipse has started and is setting on the right hand side of the diagram before the eclipse ends. Labels are provided to this effect.

Symbols are plotted showing the locations for which the Moon is in the zenith at the principal phases of the eclipse. The points at which the Moon is in the zenith at P1 and P4 are denoted by (+), at U1 and U4 by (☉) and at U2 and U3 by (⊕). These symbols are also plotted on the upper panel where appropriate. The value of ΔT used for the calculation of the eclipse circumstances is given below the diagram. Country boundaries are also provided to assist the user in determining the visibility of the eclipse at a particular location.

I. – Total Eclipse of the Sun, 2016 March 8-9

CIRCUMSTANCES OF THE ECLIPSE

Universal Time of geocentric conjunction in right ascension, March 9^d 02^h 05^m 40^s.048
Julian Date = 2457456.5872690730

	UT			Longitude	Latitude
	d	h	m	°	'
Eclipse begins	March 8	23	19.3	+102 12.9	– 7 38.0
Beginning of southern limit of umbra	9	0	16.5	+ 88 17.7	– 2 41.5
Beginning of center line; central eclipse begins	9	0	16.7	+ 88 17.1	– 2 15.2
Beginning of northern limit of umbra	9	0	16.9	+ 88 16.3	– 1 48.8
Central eclipse at local apparent noon	9	2	05.7	+151 12.7	+11 33.7
End of northern limit of umbra	9	3	37.3	–144 33.0	+33 01.7
End of center line; central eclipse ends	9	3	37.5	–144 33.0	+32 34.6
End of southern limit of umbra	9	3	37.7	–144 32.8	+32 07.5
Eclipse ends	9	4	34.9	–158 20.6	+27 12.6

BESSELIAN ELEMENTS

Let $t = (\text{UT} - 23^{\text{h}}) + \delta T/3600$ in units of hours. For times on 9 March, add 24^h to the UT before computing t .

These equations are valid over the range $0^{\text{h}}208 \leq t \leq 5^{\text{h}}750$. Do not use t outside the given range, and do not omit any terms in the series.

Intersection of the axis of shadow with the fundamental plane:

$$\begin{aligned} x &= -1.70252827 + 0.55000805\,t + 0.00008563\,t^2 - 0.00000906\,t^3 \\ y &= -0.25906893 + 0.17194793\,t + 0.00004172\,t^2 - 0.00000275\,t^3 \end{aligned}$$

Direction of the axis of shadow:

$$\begin{aligned} \sin d &= -0.07719020 + 0.00027631\,t + 0.00000003\,t^2 \\ \cos d &= +0.99701638 + 0.00002140\,t - 0.00000004\,t^2 \\ \mu &= 162^{\circ}35955314 + 15.00396192\,t + 0.00000141\,t^2 - 0.00000002\,t^3 - 0.00417807\,\delta T \end{aligned}$$

Radius of the shadow on the fundamental plane:

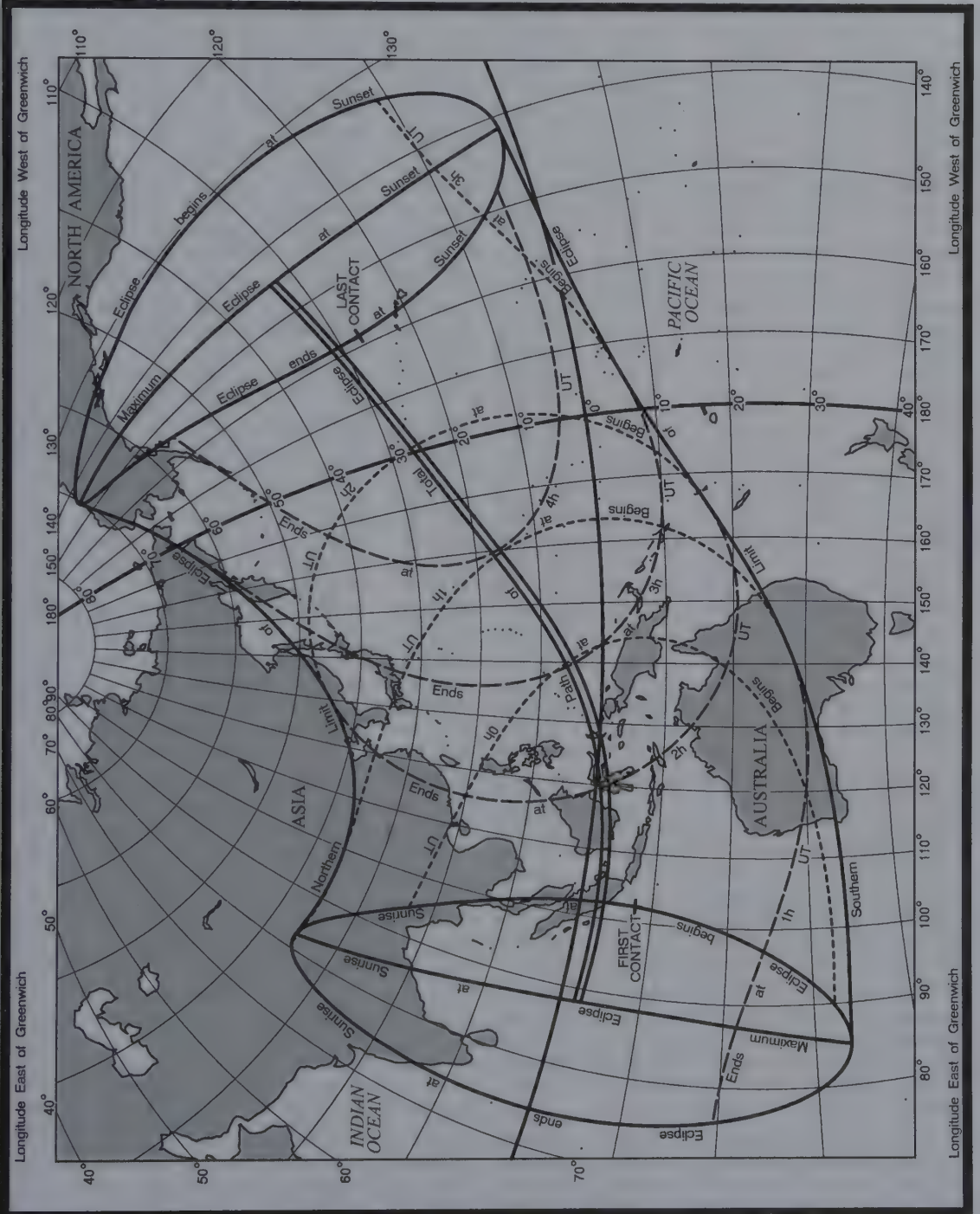
$$\begin{aligned} \text{penumbra } (l_1) &= +0.53898657 + 0.00000562\,t - 0.00001273\,t^2 \\ \text{umbra } (l_2) &= -0.00736240 + 0.00000576\,t - 0.00001273\,t^2 \end{aligned}$$

Other important quantities:

$$\begin{aligned} \tan f_1 &= +0.004709 \\ \tan f_2 &= +0.004685 \\ \mu' &= +0.261869 \text{ radians per hour} \\ d' &= +0.000277 \text{ radians per hour} \end{aligned}$$

All time arguments are given provisionally in Universal Time, using $\Delta T(A) = 68^{\circ}0$.

TOTAL SOLAR ECLIPSE OF 2016 MARCH 8-9



PATH OF CENTRAL PHASE: TOTAL SOLAR ECLIPSE OF MARCH 8-9

For limits, see Circumstances of the Eclipse.

Longitude	Latitude of			Universal Time at			On Central Line		
	Northern Limit	Central Line	Southern Limit	Northern Limit	Central Line	Southern Limit	Maximum Duration	Alt	Sun's Az
+ 94 00	- 2 08.7	- 2 36.5	- 3 04.7	0 17 29.6	0 17 18.3	0 17 05.1	1 43.6	6	94
+ 95 00	- 2 11.2	- 2 39.5	- 3 07.6	0 17 42.4	0 17 29.8	0 17 18.6	1 45.6	7	94
+ 96 00	- 2 13.1	- 2 41.8	- 3 10.5	0 17 58.8	0 17 45.1	0 17 32.4	1 47.7	8	94
+ 97 00	- 2 14.7	- 2 43.8	- 3 12.8	0 18 17.2	0 18 03.3	0 17 49.9	1 49.8	9	94
+ 98 00	- 2 16.0	- 2 45.4	- 3 14.7	0 18 38.1	0 18 23.6	0 18 10.0	1 52.0	10	94
+ 99 00	- 2 16.9	- 2 46.6	- 3 16.2	0 19 01.4	0 18 46.6	0 18 32.5	1 54.2	11	94
+100 00	- 2 17.3	- 2 47.4	- 3 17.3	0 19 27.4	0 19 12.0	0 18 57.5	1 56.4	12	94
+101 00	- 2 17.4	- 2 47.8	- 3 18.1	0 19 56.0	0 19 40.1	0 19 25.1	1 58.8	13	94
+102 00	- 2 17.0	- 2 47.8	- 3 18.4	0 20 27.3	0 20 10.9	0 19 55.4	2 01.1	15	94
+103 00	- 2 16.2	- 2 47.3	- 3 18.3	0 21 01.5	0 20 44.5	0 20 28.5	2 03.6	16	94
+104 00	- 2 15.0	- 2 46.4	- 3 17.8	0 21 38.5	0 21 20.9	0 21 04.3	2 06.1	17	94
+105 00	- 2 13.3	- 2 45.1	- 3 16.8	0 22 18.5	0 22 00.2	0 21 43.0	2 08.6	18	94
+106 00	- 2 11.0	- 2 43.2	- 3 15.3	0 23 01.5	0 22 42.6	0 22 24.7	2 11.2	19	94
+107 00	- 2 08.3	- 2 40.9	- 3 13.3	0 23 47.6	0 23 28.0	0 23 09.4	2 13.9	20	94
+108 00	- 2 05.1	- 2 38.1	- 3 10.9	0 24 36.9	0 24 16.5	0 23 57.2	2 16.6	22	94
+109 00	- 2 01.4	- 2 34.7	- 3 07.9	0 25 29.5	0 25 08.3	0 24 48.2	2 19.4	23	94
+110 00	- 1 57.1	- 2 30.8	- 3 04.4	0 26 25.4	0 26 03.4	0 25 42.5	2 22.2	24	94
+111 00	- 1 52.3	- 2 26.4	- 3 00.3	0 27 24.8	0 27 01.9	0 26 40.2	2 25.1	25	94
+112 00	- 1 46.8	- 2 21.3	- 2 55.7	0 28 27.8	0 28 03.9	0 27 41.3	2 28.1	26	94
+113 00	- 1 40.8	- 2 15.7	- 2 50.5	0 29 34.4	0 29 09.6	0 28 45.9	2 31.1	28	94
+114 00	- 1 34.2	- 2 09.5	- 2 44.6	0 30 44.8	0 30 18.9	0 29 54.2	2 34.2	29	94
+115 00	- 1 26.9	- 2 02.6	- 2 38.2	0 31 59.1	0 31 32.0	0 31 06.3	2 37.3	30	94
+116 00	- 1 18.9	- 1 55.1	- 2 31.1	0 33 17.3	0 32 49.1	0 32 22.2	2 40.5	32	94
+117 00	- 1 10.3	- 1 46.9	- 2 23.3	0 34 39.5	0 34 10.1	0 33 42.0	2 43.8	33	94
+118 00	- 1 01.0	- 1 38.0	- 2 14.9	0 36 05.9	0 35 35.2	0 35 05.9	2 47.1	34	94
+119 00	- 0 51.0	- 1 28.4	- 2 05.7	0 37 36.6	0 37 04.5	0 36 33.9	2 50.5	36	94
+120 00	- 0 40.2	- 1 18.1	- 1 55.8	0 39 11.7	0 38 38.2	0 38 06.1	2 54.0	37	95
+121 00	- 0 28.6	- 1 07.0	- 1 45.2	0 40 51.3	0 40 16.2	0 39 42.7	2 57.4	38	95
+122 00	- 0 16.3	- 0 55.1	- 1 33.8	0 42 35.4	0 41 58.8	0 41 23.8	3 01.0	40	95
+123 00	- 0 03.1	- 0 42.4	- 1 21.5	0 44 24.3	0 43 46.1	0 43 09.4	3 04.6	41	95
+124 00	+ 0 10.9	- 0 28.9	- 1 08.5	0 46 17.9	0 45 38.0	0 44 59.7	3 08.2	43	96
+125 00	+ 0 25.8	- 0 14.5	- 0 54.6	0 48 16.4	0 47 34.8	0 46 54.7	3 11.8	44	96
+126 00	+ 0 41.6	+ 0 00.7	- 0 39.8	0 50 20.0	0 49 36.4	0 48 54.6	3 15.5	46	96
+127 00	+ 0 58.2	+ 0 16.9	- 0 24.2	0 52 28.5	0 51 43.1	0 50 59.4	3 19.2	47	97
+128 00	+ 1 15.8	+ 0 34.0	- 0 07.6	0 54 42.2	0 53 54.9	0 53 09.2	3 22.9	49	97
+129 00	+ 1 34.4	+ 0 52.0	+ 0 10.0	0 57 01.1	0 56 11.8	0 55 24.1	3 26.6	50	98
+130 00	+ 1 53.9	+ 1 11.0	+ 0 28.4	0 59 25.3	0 58 33.9	0 57 44.2	3 30.2	52	99
+131 00	+ 2 14.4	+ 1 31.0	+ 0 47.9	1 01 54.7	1 01 01.2	1 00 09.5	3 33.9	53	99
+132 00	+ 2 35.9	+ 1 52.0	+ 1 08.4	1 04 29.3	1 03 33.8	1 02 39.9	3 37.5	55	100
+133 00	+ 2 58.4	+ 2 14.0	+ 1 29.9	1 07 09.3	1 06 11.6	1 05 15.6	3 41.0	56	101
+134 00	+ 3 21.9	+ 2 37.0	+ 1 52.4	1 09 54.4	1 08 54.6	1 07 56.5	3 44.5	58	103
+135 00	+ 3 46.5	+ 3 01.0	+ 2 15.9	1 12 44.7	1 11 42.8	1 10 42.6	3 47.9	59	104
+136 00	+ 4 12.0	+ 3 26.1	+ 2 40.5	1 15 40.0	1 14 36.1	1 13 33.7	3 51.1	61	105
+137 00	+ 4 38.6	+ 3 52.2	+ 3 06.1	1 18 40.2	1 17 34.3	1 16 29.9	3 54.2	63	107
+138 00	+ 5 06.2	+ 4 19.3	+ 3 32.7	1 21 45.1	1 20 37.2	1 19 30.9	3 57.2	64	109
+139 00	+ 5 34.8	+ 4 47.5	+ 4 00.4	1 24 54.4	1 23 44.8	1 22 36.5	4 00.0	66	112
+140 00	+ 6 04.3	+ 5 16.5	+ 4 29.0	1 28 07.9	1 26 56.6	1 25 46.6	4 02.6	67	114
+141 00	+ 6 34.7	+ 5 46.6	+ 4 58.6	1 31 25.2	1 30 12.5	1 29 00.8	4 05.0	68	118
+142 00	+ 7 06.0	+ 6 17.5	+ 5 29.2	1 34 46.1	1 33 32.0	1 32 18.9	4 07.1	70	121
+143 00	+ 7 38.2	+ 6 49.3	+ 6 00.6	1 38 10.0	1 36 54.8	1 35 40.4	4 09.0	71	126

PATH OF CENTRAL PHASE: TOTAL SOLAR ECLIPSE OF MARCH 8-9

Longitude	Latitude of:			Universal Time at:			On Central Line		
	Northern Limit	Central Line	Southern Limit	Northern Limit	Central Line	Southern Limit	Maximum Duration	Sun's Alt.	Sun's Az.
° ' "	° ' "	° ' "	° ' "	h m s	h m s	h m s	m s	°	°
+144 00	+ 8 11.1	+ 7 21.9	+ 6 32.9	1 41 36.5	1 40 20.5	1 39 05.1	4 10.6	72	131
+145 00	+ 8 44.6	+ 7 55.2	+ 7 05.9	1 45 05.1	1 43 48.5	1 42 32.3	4 11.9	73	136
+146 00	+ 9 18.8	+ 8 29.2	+ 7 39.7	1 48 35.3	1 47 18.3	1 46 01.6	4 13.0	74	142
+147 00	+ 9 53.6	+ 9 03.8	+ 8 14.1	1 52 06.5	1 50 49.5	1 49 32.6	4 13.7	74	149
+148 00	+10 28.8	+ 9 38.8	+ 8 49.0	1 55 38.2	1 54 21.4	1 53 04.5	4 14.0	75	157
+149 00	+11 04.3	+10 14.3	+ 9 24.4	1 59 09.7	1 57 53.5	1 56 37.0	4 14.1	75	164
+150 00	+11 40.1	+10 50.1	+10 00.1	2 02 40.5	2 01 25.1	2 00 09.3	4 13.9	75	171
+151 00	+12 16.1	+11 26.1	+10 36.2	2 06 10.0	2 04 55.8	2 03 40.9	4 13.3	74	179
+152 00	+12 52.1	+12 02.3	+11 12.4	2 09 37.7	2 08 24.9	2 07 11.2	4 12.4	74	185
+153 00	+13 28.2	+12 38.4	+11 48.7	2 13 03.0	2 11 51.9	2 10 39.8	4 11.2	73	191
+154 00	+14 04.1	+13 14.5	+12 24.9	2 16 25.5	2 15 16.3	2 14 05.9	4 09.8	72	197
+155 00	+14 39.8	+13 50.5	+13 01.1	2 19 44.7	2 18 37.6	2 17 29.2	4 08.1	70	201
+156 00	+15 15.3	+14 26.2	+13 37.1	2 23 00.2	2 21 55.4	2 20 49.2	4 06.1	69	206
+157 00	+15 50.4	+15 01.7	+14 12.8	2 26 11.7	2 25 09.4	2 24 05.5	4 04.0	68	209
+158 00	+16 25.1	+15 36.7	+14 48.2	2 29 18.8	2 28 19.1	2 27 17.7	4 01.6	67	213
+159 00	+16 59.3	+16 11.3	+15 23.2	2 32 21.4	2 31 24.4	2 30 25.6	3 59.0	65	216
+160 00	+17 33.0	+16 45.4	+15 57.7	2 35 19.2	2 34 24.9	2 33 28.8	3 56.3	64	218
+161 00	+18 06.2	+17 19.0	+16 31.7	2 38 12.0	2 37 20.5	2 36 27.2	3 53.5	62	220
+162 00	+18 38.7	+17 52.0	+17 05.1	2 40 59.7	2 40 11.1	2 39 20.6	3 50.5	61	223
+163 00	+19 10.6	+18 24.4	+17 37.9	2 43 42.3	2 42 56.5	2 42 08.8	3 47.4	59	224
+164 00	+19 41.9	+18 56.1	+18 10.1	2 46 19.7	2 45 36.7	2 44 51.8	3 44.3	58	226
+165 00	+20 12.4	+19 27.1	+18 41.6	2 48 51.9	2 48 11.7	2 47 29.6	3 41.1	56	228
+166 00	+20 42.3	+19 57.4	+19 12.4	2 51 18.9	2 50 41.4	2 50 02.0	3 37.8	55	229
+167 00	+21 11.5	+20 27.1	+19 42.5	2 53 40.7	2 53 05.9	2 52 29.2	3 34.5	53	231
+168 00	+21 39.9	+20 56.0	+20 11.9	2 55 57.5	2 55 25.2	2 54 51.1	3 31.2	52	232
+169 00	+22 07.6	+21 24.2	+20 40.6	2 58 09.1	2 57 39.4	2 57 07.9	3 27.8	50	233
+170 00	+22 34.6	+21 51.7	+21 08.6	3 00 15.8	2 59 48.6	2 59 19.5	3 24.5	49	234
+171 00	+23 00.9	+22 18.4	+21 35.8	3 02 17.7	3 01 52.8	3 01 26.1	3 21.1	48	235
+172 00	+23 26.4	+22 44.5	+22 02.3	3 04 14.8	3 03 52.1	3 03 27.8	3 17.8	46	236
+173 00	+23 51.3	+23 09.8	+22 28.1	3 06 07.3	3 05 46.8	3 05 24.6	3 14.5	45	237
+174 00	+24 15.4	+23 34.4	+22 53.2	3 07 55.2	3 07 36.8	3 07 16.7	3 11.3	43	238
+175 00	+24 38.9	+23 58.3	+23 17.6	3 09 38.7	3 09 22.2	3 09 04.3	3 08.0	42	239
+176 00	+25 01.7	+24 21.5	+23 41.3	3 11 17.9	3 11 03.3	3 10 47.3	3 04.8	41	240
+177 00	+25 23.8	+24 44.1	+24 04.3	3 12 52.9	3 12 40.2	3 12 26.0	3 01.7	39	241
+178 00	+25 45.2	+25 06.0	+24 26.6	3 14 23.9	3 14 12.9	3 14 00.4	2 58.5	38	242
+179 00	+26 06.0	+25 27.2	+24 48.3	3 15 50.9	3 15 41.5	3 15 30.8	2 55.5	37	242
180 00	+26 26.2	+25 47.8	+25 09.3	3 17 14.1	3 17 06.3	3 16 57.1	2 52.5	36	243
-179 00	+26 45.7	+26 07.7	+25 29.7	3 18 33.7	3 18 27.3	3 18 19.6	2 49.5	34	244
-178 00	+27 04.7	+26 27.1	+25 49.4	3 19 49.6	3 19 44.6	3 19 38.3	2 46.6	33	245
-177 00	+27 23.0	+26 45.8	+26 08.6	3 21 02.0	3 20 58.3	3 20 53.4	2 43.7	32	245
-176 00	+27 40.7	+27 04.0	+26 27.1	3 22 11.1	3 22 08.6	3 22 05.0	2 40.9	31	246
-175 00	+27 57.9	+27 21.5	+26 45.1	3 23 16.9	3 23 15.6	3 23 13.1	2 38.1	30	247
-174 00	+28 14.5	+27 38.5	+27 02.5	3 24 19.5	3 24 19.3	3 24 17.9	2 35.4	29	247
-173 00	+28 30.6	+27 55.0	+27 19.3	3 25 19.0	3 25 19.9	3 25 19.6	2 32.7	27	248
-172 00	+28 46.1	+28 10.9	+27 35.6	3 26 15.6	3 26 17.4	3 26 18.1	2 30.1	26	249
-171 00	+29 01.2	+28 26.3	+27 51.3	3 27 09.3	3 27 12.0	3 27 13.6	2 27.6	25	249
-170 00	+29 15.7	+28 41.1	+28 06.5	3 28 00.2	3 28 03.7	3 28 06.2	2 25.1	24	250
-169 00	+29 29.7	+28 55.5	+28 21.2	3 28 48.3	3 28 52.6	3 28 55.9	2 22.6	23	251
-168 00	+29 43.2	+29 09.3	+28 35.4	3 29 33.9	3 29 38.9	3 29 43.0	2 20.2	22	251
-167 00	+29 56.2	+29 22.7	+28 49.1	3 30 16.8	3 30 22.6	3 30 27.3	2 17.9	21	252

PATH OF CENTRAL PHASE: TOTAL SOLAR ECLIPSE OF MARCH 8-9

Longitude	Latitude of			Universal Time at			Of Central Line		
	Northern Limit	Central Line	Southern Limit	Northern Limit	Central Line	Southern Limit	Maximum Duration	Alt.	Sun's Az.
	° ' "	° ' "	° ' "	h m s	h m s	h m s	m s	°	°
-166 00	+30 08.8	+29 35.6	+29 02.4	3 30 57.3	3 31 03.7	3 31 09.1	2 15.5	20	253
-165 00	+30 20.9	+29 48.0	+29 15.1	3 31 35.4	3 31 42.4	3 31 48.4	2 13.3	19	253
-164 00	+30 32.5	+30 00.0	+29 27.4	3 32 11.2	3 32 18.7	3 32 25.2	2 11.1	18	254
-163 00	+30 43.7	+30 11.5	+29 39.3	3 32 44.7	3 32 52.6	3 32 59.7	2 08.9	17	254
-162 00	+30 54.5	+30 22.6	+29 50.7	3 33 15.9	3 33 24.3	3 33 31.9	2 06.8	16	255
-161 00	+31 04.9	+30 33.3	+30 01.7	3 33 45.0	3 33 53.9	3 34 01.9	2 04.7	15	256
-160 00	+31 14.8	+30 43.5	+30 12.2	3 34 12.1	3 34 21.3	3 34 29.7	2 02.6	14	256
-159 00	+31 24.4	+30 53.4	+30 22.4	3 34 37.1	3 34 46.6	3 34 55.4	2 00.6	13	257
-158 00	+31 33.5	+31 02.8	+30 32.1	3 35 00.1	3 35 10.0	3 35 19.1	1 58.7	12	257
-157 00	+31 42.3	+31 11.8	+30 41.4	3 35 21.2	3 35 31.3	3 35 40.8	1 56.8	11	258
-156 00	+31 50.7	+31 20.5	+30 50.4	3 35 40.4	3 35 50.8	3 36 00.5	1 54.9	10	259
-155 00	+31 58.7	+31 28.8	+30 59.0	3 35 57.8	3 36 08.5	3 36 18.4	1 53.0	9	259
-154 00	+32 06.3	+31 36.7	+31 07.2	3 36 13.5	3 36 24.3	3 36 34.5	1 51.2	8	260
-153 00	+32 13.6	+31 44.4	+31 15.1	3 36 27.3	3 36 39.0	3 36 48.9	1 49.5	7	260
-152 00	+32 20.2	+31 51.7	+31 22.4	3 36 38.0	3 36 51.4	3 37 00.9	1 47.7	6	261
-151 00	+32 26.7	+31 58.2	+31 29.2	3 36 48.2	3 37 00.8	3 37 09.9	1 46.0	6	261
-150 00	+32 33.3	+32 04.1	+31 35.9	3 36 58.4	3 37 06.9	3 37 18.9	1 44.4	5	262

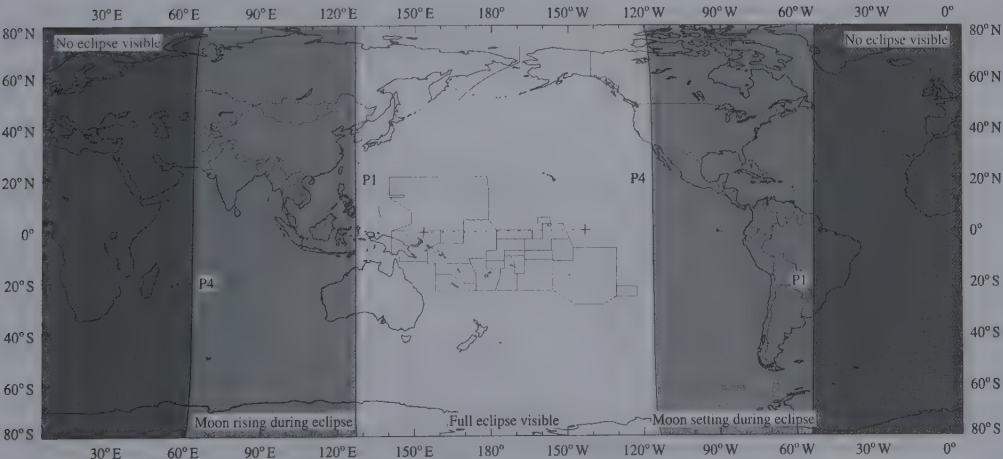
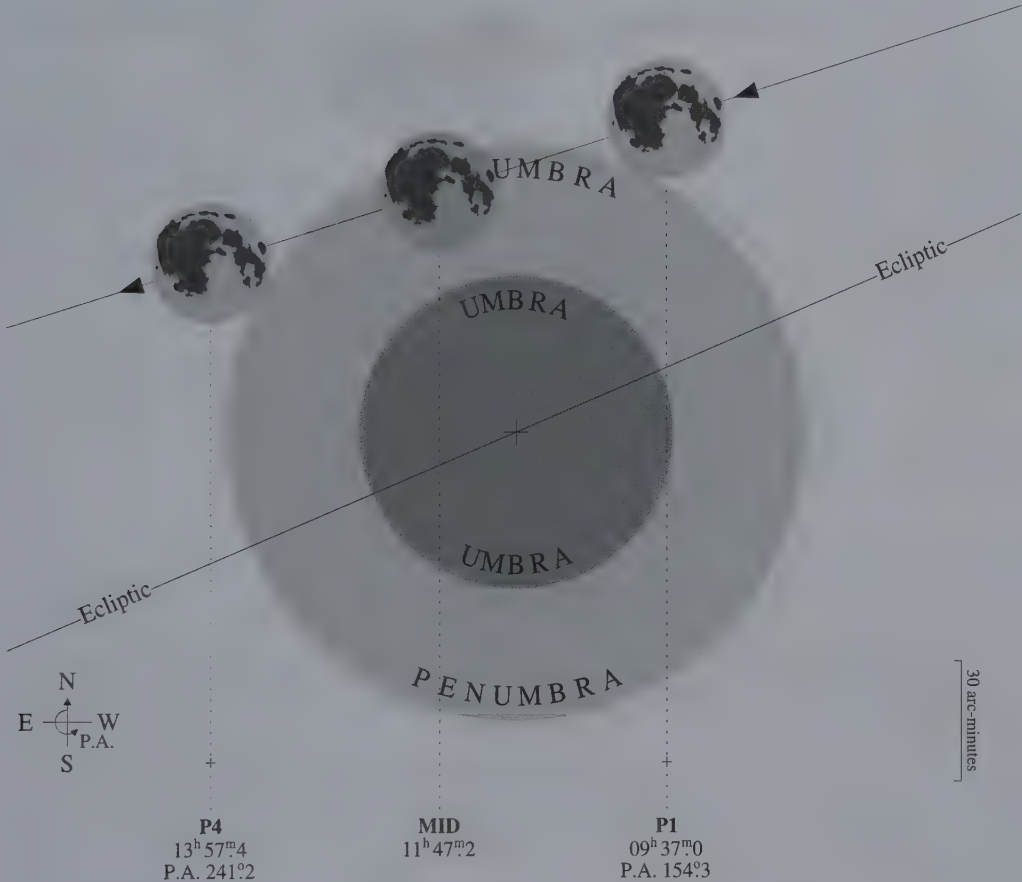
For limits, see Circumstances of the Eclipse.

II. - Penumbral Eclipse of the Moon

UT of geocentric opposition in RA: March 23^d 11^h 3^m 10^s.527

2016 March 23

Penumbral magnitude of the eclipse: 0.801

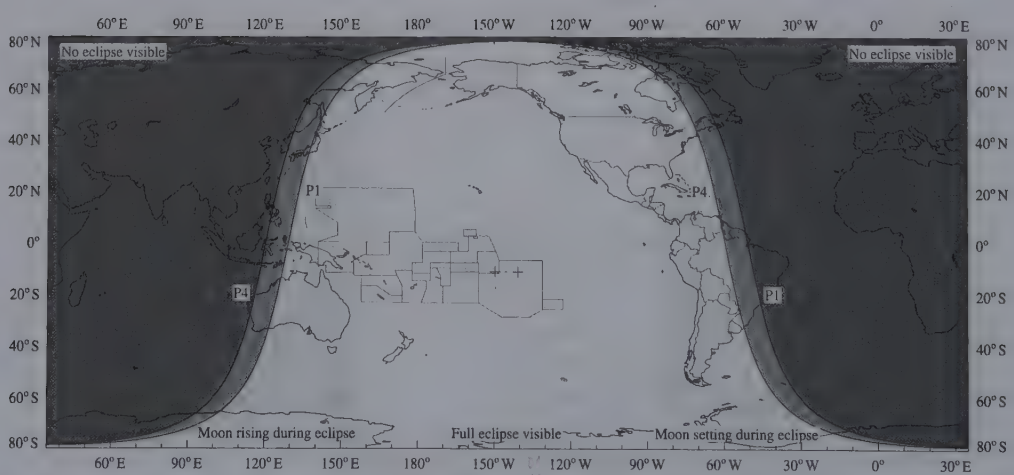
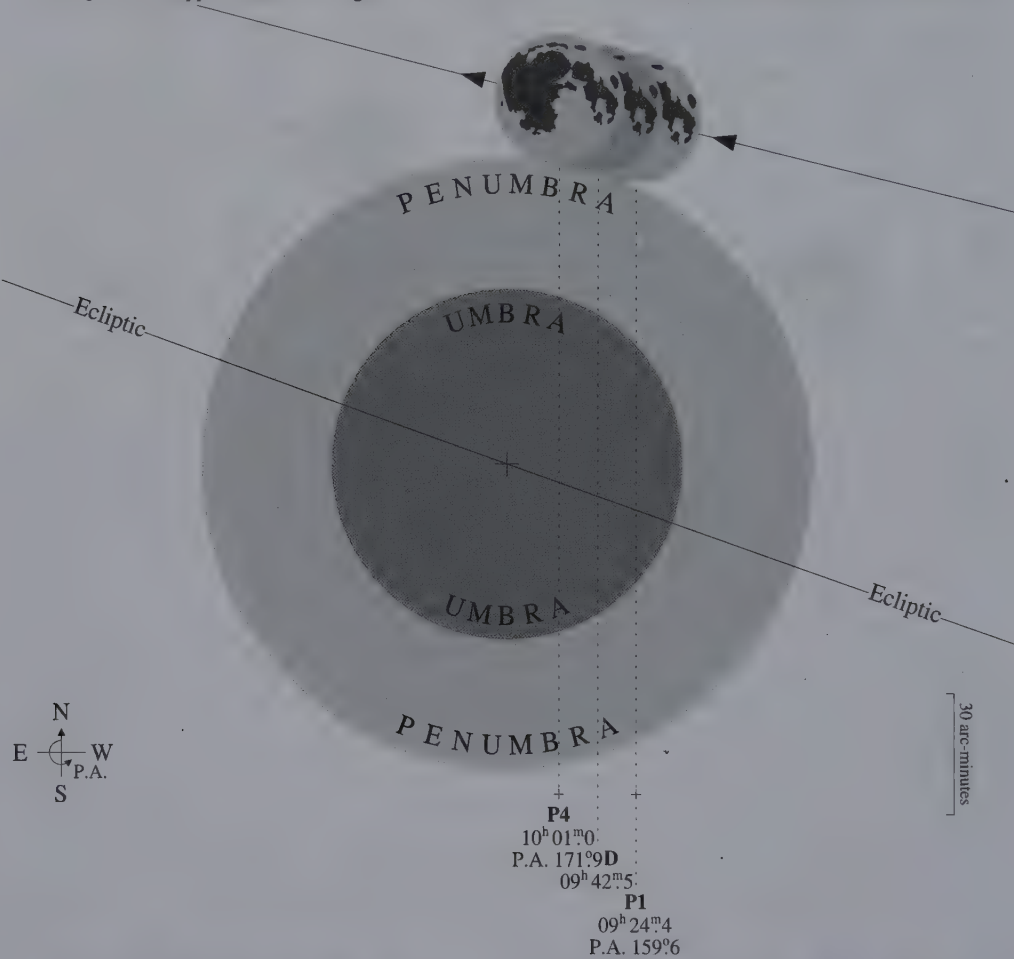


III. - Penumbral Eclipse of the Moon

UT of geocentric opposition in RA: August 18^d 10^h 25^m 39^s.940

2016 August 18

Penumbral magnitude of the eclipse: 0.017



IV. –Annular Eclipse of the Sun, 2016 September 1

CIRCUMSTANCES OF THE ECLIPSE

Universal Time of geocentric conjunction in right ascension, September 1^d 09^h 18^m 3^s.927

Julian Date = 2457632.8875454560

		UT	Longitude	Latitude
		d h m	° ′	° ′
Eclipse begins	September	1 6 13.1	– 3 52.3	+ 4 00.4
Beginning of northern limit of umbra		1 7 18.8	– 19 23.7	– 2 23.5
Beginning of center line; central eclipse begins		1 7 19.2	– 19 23.3	– 3 04.4
Beginning of southern limit of umbra		1 7 19.6	– 19 23.1	– 3 45.4
Central eclipse at local apparent noon		1 9 18.1	+ 40 27.1	–12 20.4
End of southern limit of umbra		1 10 54.0	+100 29.4	–36 20.3
End of center line; central eclipse ends		1 10 54.4	+100 32.6	–35 38.2
End of northern limit of umbra		1 10 54.8	+100 35.9	–34 56.2
Eclipse ends		1 12 00.7	+ 85 23.3	–28 35.4

BESSELIAN ELEMENTS

Let $t = (\text{UT} - 6^{\text{h}}) + \delta T/3600$ in units of hours.

These equations are valid over the range $0^{\text{h}}125 \leq t \leq 6^{\text{h}}183$. Do not use t outside the given range, and do not omit any terms in the series. If μ is greater than 360° , then subtract 360° from its computed value.

Intersection of the axis of shadow with the fundamental plane:

$$x = -1.66398095 + 0.50402311 t + 0.00003502 t^2 - 0.00000631 t^3$$

$$y = +0.14160082 - 0.14795047 t - 0.00004181 t^2 + 0.00000179 t^3$$

Direction of the axis of shadow:

$$\sin d = +0.14102949 - 0.00025559 t - 0.00000003 t^2$$

$$\cos d = +0.99000539 + 0.00003641 t - 0.00000003 t^2$$

$$\mu = 270^\circ 01' 24.117'' + 15.00453795 t + 0.00000103 t^2 - 0.00000001 t^3 - 0.00417807 \delta T$$

Radius of the shadow on the fundamental plane:

$$\text{penumbra } (l_1) = +0.55752520 + 0.00017406 t - 0.00001051 t^2$$

$$\text{umbra } (l_2) = +0.01108420 + 0.00017320 t - 0.00001046 t^2$$

Other important quantities:

$$\tan f_1 = +0.004634$$

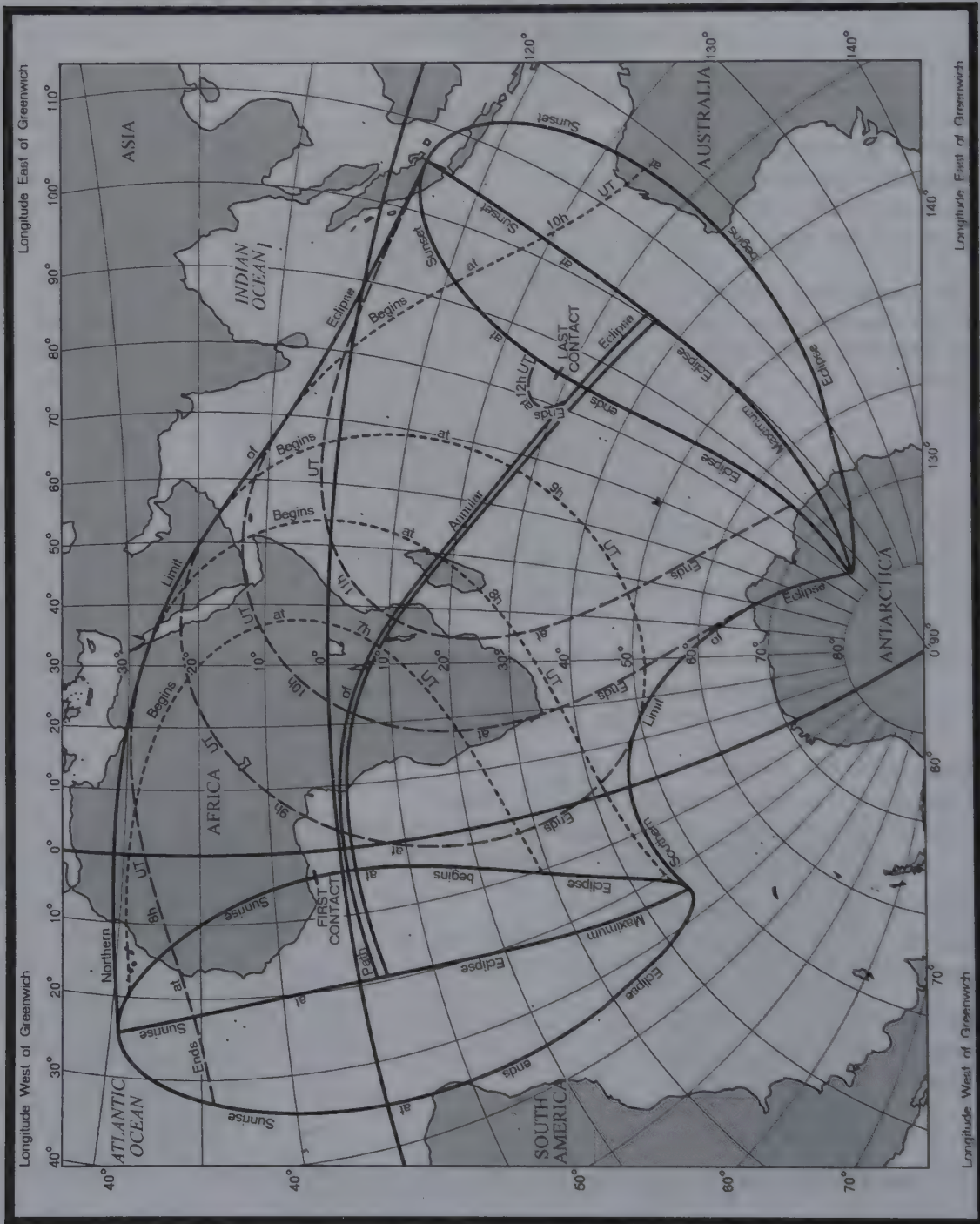
$$\tan f_2 = +0.004610$$

$$\mu' = +0.261878 \text{ radians per hour}$$

$$d' = -0.000258 \text{ radians per hour}$$

All time arguments are given provisionally in Universal Time, using $\Delta T(A) = 68^{\text{s}}.0$.

ANNULAR SOLAR ECLIPSE OF 2016 SEPTEMBER 1



PATH OF CENTRAL PHASE: ANNULAR SOLAR ECLIPSE OF SEPTEMBER 1

For limits, see Circumstances of the Eclipse.

Longitude	Latitude of:			Universal Time at:			On Central Line		
	Northern Limit	Central Line	Southern Limit	Northern Limit	Central Line	Southern Limit	Maximum Duration	Sun's Alt.	Sun's Az.
° ' "	° ' "	° ' "	° ' "	h m s	h m s	h m s	m s	°	°
- 14 00	- 1 42.7	- 2 22.1	- 3 01.5	7 19 26.4	7 19 48.8	7 20 10.9	2 39.5	6	82
- 13 00	- 1 35.9	- 2 14.9	- 2 54.2	7 19 39.1	7 20 01.3	7 20 24.8	2 39.8	7	82
- 12 00	- 1 29.5	- 2 08.2	- 2 47.1	7 19 56.2	7 20 18.2	7 20 40.9	2 40.1	8	82
- 11 00	- 1 23.5	- 2 01.9	- 2 40.5	7 20 16.0	7 20 38.1	7 21 00.9	2 40.4	9	81
- 10 00	- 1 17.8	- 1 55.9	- 2 34.1	7 20 38.6	7 21 00.8	7 21 23.6	2 40.7	10	81
- 9 00	- 1 12.4	- 1 50.2	- 2 28.2	7 21 04.0	7 21 26.3	7 21 49.3	2 41.0	11	81
- 8 00	- 1 07.4	- 1 44.9	- 2 22.6	7 21 32.3	7 21 54.8	7 22 17.9	2 41.3	12	81
- 7 00	- 1 02.8	- 1 40.0	- 2 17.4	7 22 03.7	7 22 26.4	7 22 49.7	2 41.6	13	81
- 6 00	- 0 58.6	- 1 35.5	- 2 12.5	7 22 38.3	7 23 01.1	7 23 24.7	2 42.0	14	81
- 5 00	- 0 54.8	- 1 31.4	- 2 08.1	7 23 16.0	7 23 39.1	7 24 02.9	2 42.3	16	81
- 4 00	- 0 51.4	- 1 27.7	- 2 04.1	7 23 57.1	7 24 20.5	7 24 44.5	2 42.7	17	81
- 3 00	- 0 48.4	- 1 24.4	- 2 00.6	7 24 41.6	7 25 05.3	7 25 29.5	2 43.0	18	81
- 2 00	- 0 45.9	- 1 21.6	- 1 57.5	7 25 29.7	7 25 53.7	7 26 18.2	2 43.4	19	81
- 1 00	- 0 43.9	- 1 19.3	- 1 54.8	7 26 21.4	7 26 45.7	7 27 10.5	2 43.8	20	81
0 00	- 0 42.3	- 1 17.5	- 1 52.7	7 27 16.8	7 27 41.4	7 28 06.7	2 44.2	22	81
+ 1 00	- 0 41.3	- 1 16.1	- 1 51.1	7 28 16.1	7 28 41.1	7 29 06.7	2 44.6	23	81
+ 2 00	- 0 40.8	- 1 15.4	- 1 50.1	7 29 19.3	7 29 44.8	7 30 10.8	2 45.1	24	81
+ 3 00	- 0 40.9	- 1 15.2	- 1 49.6	7 30 26.7	7 30 52.6	7 31 19.0	2 45.5	25	80
+ 4 00	- 0 41.5	- 1 15.5	- 1 49.7	7 31 38.2	7 32 04.6	7 32 31.6	2 45.9	27	80
+ 5 00	- 0 42.8	- 1 16.5	- 1 50.4	7 32 54.1	7 33 21.0	7 33 48.5	2 46.4	28	80
+ 6 00	- 0 44.7	- 1 18.1	- 1 51.7	7 34 14.5	7 34 42.0	7 35 10.0	2 46.9	29	80
+ 7 00	- 0 47.2	- 1 20.4	- 1 53.7	7 35 39.5	7 36 07.6	7 36 36.1	2 47.3	30	80
+ 8 00	- 0 50.5	- 1 23.4	- 1 56.5	7 37 09.2	7 37 37.9	7 38 07.1	2 47.8	32	80
+ 9 00	- 0 54.4	- 1 27.1	- 1 59.9	7 38 43.9	7 39 13.3	7 39 43.1	2 48.3	33	79
+ 10 00	- 0 59.1	- 1 31.5	- 2 04.1	7 40 23.6	7 40 53.7	7 41 24.2	2 48.8	35	79
+ 11 00	- 1 04.6	- 1 36.8	- 2 09.1	7 42 08.4	7 42 39.3	7 43 10.6	2 49.4	36	79
+ 12 00	- 1 10.8	- 1 42.8	- 2 14.9	7 43 58.7	7 44 30.3	7 45 02.4	2 49.9	37	78
+ 13 00	- 1 17.9	- 1 49.7	- 2 21.5	7 45 54.4	7 46 26.9	7 46 59.8	2 50.4	39	78
+ 14 00	- 1 25.9	- 1 57.5	- 2 29.1	7 47 55.8	7 48 29.2	7 49 03.0	2 50.9	40	78
+ 15 00	- 1 34.8	- 2 06.1	- 2 37.6	7 50 03.0	7 50 37.3	7 51 12.0	2 51.5	42	77
+ 16 00	- 1 44.7	- 2 15.8	- 2 47.1	7 52 16.1	7 52 51.4	7 53 27.1	2 52.0	43	77
+ 17 00	- 1 55.5	- 2 26.4	- 2 57.5	7 54 35.4	7 55 11.6	7 55 48.3	2 52.6	45	76
+ 18 00	- 2 07.3	- 2 38.1	- 3 09.1	7 57 00.9	7 57 38.2	7 58 15.9	2 53.1	46	75
+ 19 00	- 2 20.3	- 2 50.9	- 3 21.7	7 59 32.7	8 00 11.1	8 00 49.9	2 53.7	48	75
+ 20 00	- 2 34.3	- 3 04.8	- 3 35.4	8 02 11.1	8 02 50.6	8 03 30.5	2 54.2	49	74
+ 21 00	- 2 49.4	- 3 19.8	- 3 50.3	8 04 56.0	8 05 36.6	8 06 17.7	2 54.7	51	73
+ 22 00	- 3 05.8	- 3 36.0	- 4 06.4	8 07 47.6	8 08 29.4	8 09 11.6	2 55.3	52	72
+ 23 00	- 3 23.3	- 3 53.5	- 4 23.8	8 10 45.9	8 11 28.9	8 12 12.3	2 55.8	54	71
+ 24 00	- 3 42.1	- 4 12.2	- 4 42.4	8 13 51.0	8 14 35.2	8 15 19.7	2 56.3	55	69
+ 25 00	- 4 02.2	- 4 32.2	- 5 02.3	8 17 02.8	8 17 48.2	8 18 33.9	2 56.7	57	68
+ 26 00	- 4 23.5	- 4 53.5	- 5 23.6	8 20 21.3	8 21 07.8	8 21 54.8	2 57.2	59	66
+ 27 00	- 4 46.2	- 5 16.2	- 5 46.2	8 23 46.3	8 24 34.1	8 25 22.2	2 57.6	60	64
+ 28 00	- 5 10.2	- 5 40.2	- 6 10.2	8 27 17.8	8 28 06.7	8 28 55.9	2 58.0	62	61
+ 29 00	- 5 35.6	- 6 05.5	- 6 35.6	8 30 55.4	8 31 45.4	8 32 35.7	2 58.4	63	59
+ 30 00	- 6 02.3	- 6 32.2	- 7 02.3	8 34 39.0	8 35 29.9	8 36 21.3	2 58.7	64	56
+ 31 00	- 6 30.3	- 7 00.3	- 7 30.4	8 38 28.0	8 39 19.9	8 40 12.2	2 59.0	66	52
+ 32 00	- 6 59.5	- 7 29.6	- 7 59.8	8 42 22.1	8 43 14.8	8 44 07.9	2 59.3	67	48
+ 33 00	- 7 30.1	- 8 00.2	- 8 30.5	8 46 20.7	8 47 14.2	8 48 07.9	2 59.5	68	44
+ 34 00	- 8 01.8	- 8 32.0	- 9 02.4	8 50 23.2	8 51 17.3	8 52 11.6	2 59.7	69	39
+ 35 00	- 8 34.7	- 9 05.0	- 9 35.4	8 54 29.0	8 55 23.5	8 56 18.2	2 59.8	70	33

PATH OF CENTRAL PHASE: ANNULAR SOLAR ECLIPSE OF SEPTEMBER 1

Longitude	Latitude of:			Universal Time at:			On Central Line		
	Northern Limit	Central Line	Southern Limit	Northern Limit	Central Line	Southern Limit	Maximum Duration	Sun's Alt.	Sun's Az.
° /	° /	° /	° /	h m s	h m s	h m s	m s	°	°
+ 36 00	- 9 08.6	- 9 39.0	-10 09.6	8 58 37.2	8 59 32.0	9 00 27.0	2 59.9	70	27
+ 37 00	- 9 43.4	-10 13.9	-10 44.6	9 02 47.1	9 03 42.0	9 04 37.0	2 59.9	70	21
+ 38 00	-10 19.1	-10 49.7	-11 20.6	9 06 57.8	9 07 52.6	9 08 47.5	2 59.9	70	15
+ 39 00	-10 55.5	-11 26.3	-11 57.3	9 11 08.4	9 12 02.9	9 12 57.5	2 59.9	70	9
+ 40 00	-11 32.6	-12 03.5	-12 34.6	9 15 18.1	9 16 12.1	9 17 06.2	2 59.8	70	3
+ 41 00	-12 10.1	-12 41.1	-13 12.3	9 19 26.0	9 20 19.3	9 21 12.7	2 59.7	69	357
+ 42 00	-12 48.0	-13 19.1	-13 50.5	9 23 31.2	9 24 23.7	9 25 16.1	2 59.5	68	352
+ 43 00	-13 26.1	-13 57.3	-14 28.8	9 27 33.0	9 28 24.5	9 29 15.8	2 59.3	67	347
+ 44 00	-14 04.3	-14 35.7	-15 07.3	9 31 30.7	9 32 20.9	9 33 11.0	2 59.1	66	342
+ 45 00	-14 42.4	-15 14.0	-15 45.7	9 35 23.5	9 36 12.4	9 37 01.1	2 58.9	65	338
+ 46 00	-15 20.4	-15 52.1	-16 24.0	9 39 11.0	9 39 58.4	9 40 45.5	2 58.6	64	335
+ 47 00	-15 58.2	-16 30.0	-17 02.1	9 42 52.6	9 43 38.4	9 44 23.9	2 58.4	62	331
+ 48 00	-16 35.7	-17 07.6	-17 39.8	9 46 28.0	9 47 12.1	9 47 55.8	2 58.1	61	329
+ 49 00	-17 12.7	-17 44.7	-18 17.0	9 49 56.9	9 50 39.1	9 51 21.0	2 57.8	59	326
+ 50 00	-17 49.2	-18 21.4	-18 53.8	9 53 18.9	9 53 59.3	9 54 39.3	2 57.5	58	324
+ 51 00	-18 25.2	-18 57.5	-19 30.1	9 56 34.0	9 57 12.5	9 57 50.5	2 57.2	56	322
+ 52 00	-19 00.5	-19 33.0	-20 05.7	9 59 42.1	10 00 18.6	10 00 54.7	2 56.8	55	320
+ 53 00	-19 35.2	-20 07.9	-20 40.7	10 02 43.1	10 03 17.6	10 03 51.7	2 56.5	53	318
+ 54 00	-20 09.3	-20 42.0	-21 15.0	10 05 37.0	10 06 09.6	10 06 41.7	2 56.2	52	316
+ 55 00	-20 42.6	-21 15.5	-21 48.7	10 08 24.0	10 08 54.6	10 09 24.7	2 55.8	50	315
+ 56 00	-21 15.1	-21 48.2	-22 21.5	10 11 04.1	10 11 32.7	10 12 00.8	2 55.5	49	313
+ 57 00	-21 47.0	-22 20.2	-22 53.7	10 13 37.4	10 14 04.0	10 14 30.2	2 55.1	47	312
+ 58 00	-22 18.1	-22 51.4	-23 25.1	10 16 04.1	10 16 28.8	10 16 53.0	2 54.8	46	311
+ 59 00	-22 48.4	-23 21.9	-23 55.7	10 18 24.3	10 18 47.1	10 19 09.4	2 54.5	44	310
+ 60 00	-23 17.9	-23 51.7	-24 25.7	10 20 38.3	10 20 59.2	10 21 19.6	2 54.1	43	308
+ 61 00	-23 46.8	-24 20.7	-24 54.8	10 22 46.1	10 23 05.2	10 23 23.7	2 53.8	42	307
+ 62 00	-24 14.8	-24 48.9	-25 23.2	10 24 48.1	10 25 05.4	10 25 22.0	2 53.4	40	306
+ 63 00	-24 42.2	-25 16.4	-25 50.9	10 26 44.4	10 26 59.8	10 27 14.7	2 53.1	39	305
+ 64 00	-25 08.8	-25 43.2	-26 17.9	10 28 35.1	10 28 48.9	10 29 02.0	2 52.8	38	305
+ 65 00	-25 34.7	-26 09.3	-26 44.2	10 30 20.5	10 30 32.6	10 30 44.0	2 52.5	36	304
+ 66 00	-25 59.8	-26 34.7	-27 09.7	10 32 00.8	10 32 11.2	10 32 21.0	2 52.1	35	303
+ 67 00	-26 24.3	-26 59.4	-27 34.6	10 33 36.1	10 33 44.9	10 33 53.1	2 51.8	34	302
+ 68 00	-26 48.2	-27 23.4	-27 58.8	10 35 06.7	10 35 14.0	10 35 20.6	2 51.5	32	301
+ 69 00	-27 11.3	-27 46.7	-28 22.4	10 36 32.7	10 36 38.4	10 36 43.5	2 51.2	31	300
+ 70 00	-27 33.8	-28 09.4	-28 45.3	10 37 54.3	10 37 58.5	10 38 02.2	2 50.9	30	300
+ 71 00	-27 55.7	-28 31.5	-29 07.6	10 39 11.6	10 39 14.4	10 39 16.6	2 50.6	29	299
+ 72 00	-28 17.0	-28 53.0	-29 29.3	10 40 24.8	10 40 26.3	10 40 27.1	2 50.3	28	298
+ 73 00	-28 37.6	-29 13.9	-29 50.3	10 41 34.1	10 41 34.2	10 41 33.7	2 50.0	27	297
+ 74 00	-28 57.7	-29 34.1	-30 10.8	10 42 39.6	10 42 38.4	10 42 36.5	2 49.7	25	297
+ 75 00	-29 17.2	-29 53.8	-30 30.7	10 43 41.4	10 43 39.0	10 43 35.9	2 49.4	24	296
+ 76 00	-29 36.1	-30 13.0	-30 50.1	10 44 39.8	10 44 36.1	10 44 31.8	2 49.2	23	295
+ 77 00	-29 54.5	-30 31.6	-31 08.9	10 45 34.7	10 45 29.9	10 45 24.3	2 48.9	22	294
+ 78 00	-30 12.3	-30 49.6	-31 27.2	10 46 26.4	10 46 20.4	10 46 13.7	2 48.6	21	294
+ 79 00	-30 29.6	-31 07.1	-31 44.9	10 47 14.9	10 47 07.9	10 47 00.1	2 48.3	20	293
+ 80 00	-30 46.4	-31 24.2	-32 02.2	10 48 00.4	10 47 52.3	10 47 43.4	2 48.1	19	292
+ 81 00	-31 02.7	-31 40.7	-32 18.9	10 48 43.0	10 48 33.9	10 48 24.0	2 47.8	18	292
+ 82 00	-31 18.5	-31 56.7	-32 35.2	10 49 22.8	10 49 12.6	10 49 01.7	2 47.6	17	291
+ 83 00	-31 33.9	-32 12.3	-32 51.0	10 49 59.8	10 49 48.7	10 49 36.8	2 47.3	16	291
+ 84 00	-31 48.8	-32 27.4	-33 06.3	10 50 34.2	10 50 22.2	10 50 09.4	2 47.1	15	290
+ 85 00	-32 03.2	-32 42.1	-33 21.1	10 51 06.1	10 50 53.1	10 50 39.5	2 46.8	14	289

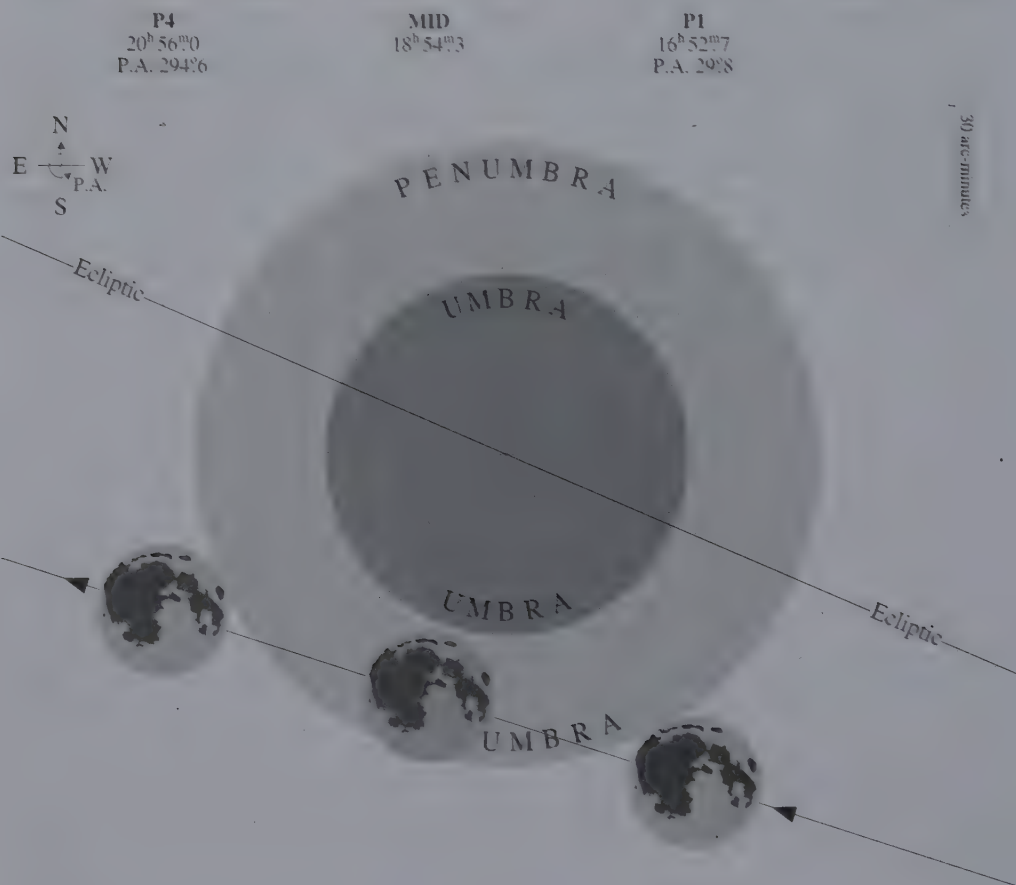
PATH OF CENTRAL PHASE: ANNULAR SOLAR ECLIPSE OF SEPTEMBER 1

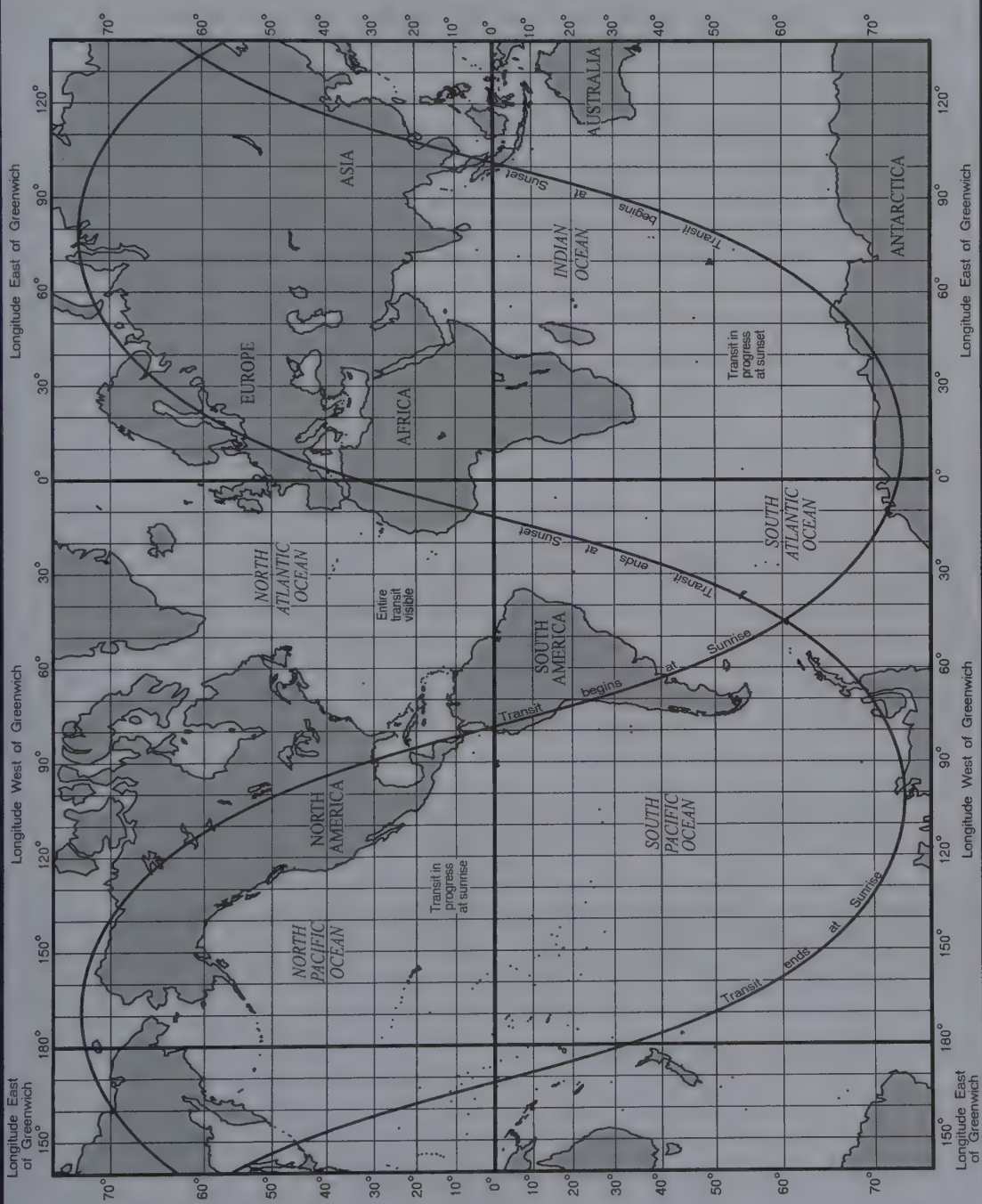
Longitude	Latitude of:			Universal Time at:			On Central Line		
	Northern Limit	Central Line	Southern Limit	Northern Limit	Central Line	Southern Limit	Maximum Duration	Sun's Alt.	Sun's Az.
° ' "	° ' "	° ' "	° ' "	h m s	h m s	h m s	m s	°	°
+ 86 00	-32 17.2	-32 56.3	-33 35.6	10 51 35.5	10 51 21.7	10 51 07.2	2 46.6	13	289
+ 87 00	-32 30.7	-33 10.0	-33 49.6	10 52 02.5	10 51 47.9	10 51 32.5	2 46.4	12	288
+ 88 00	-32 43.8	-33 23.4	-34 03.1	10 52 27.2	10 52 11.9	10 51 55.7	2 46.1	11	287
+ 89 00	-32 56.5	-33 36.3	-34 16.3	10 52 49.7	10 52 33.6	10 52 16.7	2 45.9	10	287
+ 90 00	-33 08.8	-33 48.8	-34 29.1	10 53 10.1	10 52 53.2	10 52 35.6	2 45.7	9	286
+ 91 00	-33 20.7	-34 01.0	-34 41.4	10 53 28.3	10 53 10.9	10 52 52.5	2 45.5	8	286
+ 92 00	-33 32.3	-34 12.7	-34 53.5	10 53 44.7	10 53 26.4	10 53 08.0	2 45.3	7	285
+ 93 00	-33 43.4	-34 23.8	-35 05.1	10 53 58.8	10 53 38.7	10 53 21.1	2 45.1	6	284
+ 94 00	-33 53.8	-34 34.8	-35 16.0	10 54 09.6	10 53 50.4	10 53 31.0	2 44.9	6	284

For limits, see Circumstances of the Eclipse.

V. - Penumbral Eclipse of the Moon

2016 September 16





A transit of Mercury over the disk of the Sun will occur on May 9. The entire transit will be visible in eastern North America, northern South America, the Arctic, Greenland, extreme northwestern Africa, western Europe, and the Atlantic Ocean.

The times provided in the following tables are given provisionally in Universal Time, using $\Delta T(A) = +68^s.0$. Once the value of ΔT is known, the data on these pages may be expressed in Universal Time as follows:

Define $\delta T = \Delta T - \Delta T(A)$, in units of seconds of time.

Change the times given in provisional Universal Time by subtracting δT .

Apply the correction $0.00417807 \delta T$ to the longitudes in such a way that if δT is positive, the longitudes shift to the east.

Leave all other quantities unchanged.

Longitude is positive to the east and negative to the west.

GEOCENTRIC PHASES

	UT	Position Angle P	Mercury being in the Zenith in	
			Longitude	Latitude
	d h m s	"	"	"
Ingress, exterior contact	May 9 11 12 17.6	83.2	+ 11 18.6	+17 34.1
Ingress, interior contact	9 11 15 29.5	83.5	+ 10 30.4	+17 34.0
Least angular distance	9 14 57 25.3	153.8	- 45 12.6	+17 29.9
Egress, interior contact	9 18 39 12.8	224.1	-100 53.5	+17 25.8
Egress, exterior contact	9 18 42 24.8	224.4	-101 41.7	+17 25.7

Least angular distance: $5' 18''.5$

The position angle P of the point of contact is reckoned from the north point of the limb of the Sun towards the east as viewed at the geocenter.

The position angle V of the point of contact, reckoned from the vertex of the limb of the Sun towards the east, is found by:

$$V = P - C$$

where C , the parallactic angle, is given by:

$$\tan C = \frac{\cos \phi' \sin h}{\sin \phi' \cos \delta - \cos \phi' \sin \delta \cos h}$$

in which ϕ' is the geocentric latitude of the place, δ is the declination of the Sun, and h is the local hour angle of the Sun; $\sin C$ has the same algebraic sign as $\sin h$.

Location	Position		Ingress Exterior Contact		Ingress Interior Contact		Least Angular Distance		Egress Interior Contact		Egress Exterior Contact	
	Latitude	Longitude	UT	P	UT	P	UT	P	UT	P	UT	P
United States												
Hartford, CT	+41 46.2	- 72 40.6	11 13 32.7	83.6	11 16 45.0	83.9	14 57 51.9	5 22.4	18 38 10.1	224.0	18 41 21.4	224.3
Boston, MA	+42 20.0	- 71 05.0	11 13 31.7	83.6	11 16 43.9	83.8	14 57 49.4	5 22.3	18 38 08.0	224.0	18 41 19.3	224.3
New York, NY	+40 44.0	- 74 00.0	11 13 34.3	83.6	11 16 46.7	83.9	14 57 54.7	5 22.4	18 38 12.4	224.0	18 41 23.6	224.3
Washington, DC	+38 53.7	- 77 02.2	11 13 37.0	83.6	11 16 49.4	83.9	14 58 00.5	5 22.3	18 38 17.3	224.0	18 41 28.5	224.3
Raleigh, NC	+35 49.1	- 78 38.7	11 13 41.1	83.6	11 16 53.6	83.8	14 58 06.7	5 22.2	18 38 22.2	224.0	18 41 33.3	224.3
Atlanta, GA	+33 45.3	- 84 23.4	11 13 43.1	83.6	11 16 55.6	83.8	14 58 15.2	5 22.3	18 38 31.1	224.0	18 41 42.2	224.3
Miami, FL	+25 45.0	- 80 15.0	11 13 52.8	83.5	11 17 05.2	83.8	14 58 22.4	5 21.4	18 38 35.2	224.1	18 41 46.1	224.4
Montgomery, AL	+32 21.7	- 86 16.8	11 13 44.3	83.6	11 16 56.9	83.8	14 58 19.0	5 22.3	18 38 34.9	224.0	18 41 46.0	224.3
Detroit, MI	+42 19.9	- 83 02.8	11 13 31.7	83.6	11 16 44.2	83.9	14 58 00.7	5 22.9	18 38 20.5	224.0	18 41 31.8	224.2
Indianapolis, IN	+39 47.5	- 86 08.9	11 13 34.7	83.6	11 16 47.3	83.9	14 58 07.3	5 22.9	18 38 26.5	224.0	18 41 37.7	224.3
Chicago, IL	+41 50.0	- 87 38.0	11 13 31.5	83.6	11 16 44.1	83.9	14 58 05.2	5 23.1	18 38 25.9	224.0	18 41 37.2	224.2
Milwaukee, WI	+43 03.0	- 87 57.0	11 13 29.6	83.6	11 16 42.3	83.9	14 58 03.4	5 23.2	18 38 24.9	224.0	18 41 36.2	224.2
Minneapolis, MN	+44 58.8	- 93 15.1	11 13 25.0	83.6	11 16 37.8	83.9	14 58 03.5	5 23.5	18 38 28.2	223.9	18 41 39.6	224.2
St. Louis, MO	+38 40.0	- 90 15.0	11 13 35.1	83.6	11 16 47.7	83.9	14 58 12.3	5 23.0	18 38 32.2	224.0	18 41 43.5	224.3
Louisville, KY	+38 15.3	- 85 45.6	11 13 36.9	83.6	11 16 49.5	83.9	14 58 09.5	5 22.7	18 38 27.7	224.0	18 41 38.9	224.3
Lincoln, NE	+40 48.6	- 96 40.5	..	..	..	..	14 58 12.8	5 23.4	18 38 36.6	224.0	18 41 47.9	224.2
Oklahoma City, OK	+35 28.9	- 97 32.1	..	..	..	..	14 58 22.3	5 23.1	18 38 44.3	224.0	18 41 55.5	224.3
Denver, CO	+39 44.4	-104 59.1	..	..	..	..	14 58 18.5	5 23.7	18 38 46.6	223.9	18 41 58.0	224.2
Salt Lake City, UT	+40 45.0	-111 55.0	..	..	..	..	14 58 18.6	5 24.1	18 38 52.0	223.9	18 42 03.5	224.2
Dallas, TX	+32 47.0	- 96 48.2	..	..	..	..	14 58 26.2	5 22.9	18 38 46.9	224.0	18 41 58.1	224.3
Houston, TX	+29 45.0	- 95 25.0	..	..	..	..	14 58 30.1	5 22.5	18 38 49.2	224.0	18 42 00.3	224.3
Albuquerque, NM	+35 06.6	-106 36.6	..	..	..	..	14 58 27.1	5 23.5	18 38 54.8	224.0	18 42 06.0	224.2
Las Vegas, NV	+36 10.6	-115 08.2	..	..	..	..	14 58 27.2	5 23.9	18 39 02.0	223.9	18 42 13.4	224.2
Los Angeles, CA	+34 03.0	-118 15.0	..	..	..	..	14 58 31.1	5 23.9	18 39 08.3	223.9	18 42 19.7	224.2
San Diego, CA	+32 42.9	-117 09.7	..	..	..	..	14 58 33.3	5 23.8	18 39 09.3	224.0	18 42 20.7	224.2
San Francisco, CA	+37 46.8	-122 25.2	..	..	..	..	14 58 24.5	5 24.3	18 39 06.2	223.9	18 42 17.7	224.2
Portland, OR	+45 32.0	-122 40.0	..	..	..	..	14 58 10.2	5 24.7	18 38 54.0	223.9	18 42 05.7	224.1
Seattle, WA	+47 36.6	-122 20.0	..	..	..	..	14 58 06.2	5 24.8	18 38 50.5	223.9	18 42 02.2	224.1
Fairbanks, AK	+64 50.0	-147 50.0	..	..	..	..	14 57 25.9	5 25.5	18 38 34.3	223.7	18 41 46.5	224.0
Nome, AK	+53 53.3	-166 31.6	..	..	..	..	14 57 17.6	5 25.6	18 38 38.0	223.7	18 41 50.4	224.0
Unalaksa, AK	+21 18.5	-157 49.6	..	..	..	..	..	..	18 38 58.4	223.7	18 42 10.7	224.0
Honolulu, HI	..	..	..	..	..	..	..	..	18 39 58.2	223.9	18 43 10.2	224.1
Canada												
St. John's, Nfld.	+47 34.1	- 52 42.4	11 13 17.4	83.6	11 16 29.4	83.8	14 57 22.1	5 22.0	18 37 47.7	224.0	18 40 59.2	224.2
Moncton, N.B.	+46 07.0	- 64 48.2	11 13 24.7	83.6	11 16 36.8	83.8	14 57 37.5	5 22.4	18 37 59.2	224.0	18 41 10.5	224.2
Halifax, N.S.	+44 38.0	- 63 35.0	11 13 26.5	83.6	11 16 38.6	83.8	14 57 38.1	5 22.2	18 37 58.9	224.0	18 41 10.3	224.3
Charlottetown, P.E.I.	+46 14.4	- 63 08.4	11 13 24.0	83.6	11 16 36.1	83.8	14 57 35.6	5 22.3	18 37 57.5	224.0	18 41 08.9	224.2
Montreal, Que.	+45 30.5	- 73 33.2	11 13 27.2	83.6	11 16 39.6	83.9	14 57 47.3	5 22.7	18 38 08.0	224.0	18 41 19.4	224.2
Toronto, Ont.	+43 43.0	- 79 20.4	11 13 30.0	83.6	11 16 42.5	83.9	14 57 55.3	5 22.8	18 38 15.3	224.0	18 41 26.6	224.2
Thunder Bay, Ont.	+48 22.9	- 89 14.8	11 13 21.2	83.6	11 16 33.9	83.9	14 57 55.1	5 23.6	18 38 20.7	223.9	18 41 32.1	224.2
Winnipeg, Man.	+49 54.0	- 97 08.0	11 13 16.0	83.6	11 16 28.8	83.9	14 57 56.7	5 24.0	18 38 26.3	223.9	18 41 37.8	224.2

TRANSIT OF MERCURY OF 2016 MAY 9

Location	Position		Ingress Exterior Contact		Ingress Interior Contact		Least Angular Distance		Egress Interior Contact		Egress Exterior Contact	
	Latitude	Longitude	UT	P	UT	P	UT	P	UT	P	UT	P
Canada												
Edmonton, Alta.	+53 34.6	-113 31.0	h m s	o	h m s	o	h m s	o	h m s	o	h m s	o
Iqaluit, Nunavut	+63 44.9	-68 31.2	11 12 55.7	83.6	11 16 08.1	83.9	14 57 54.3	5 24.7	18 38 35.1	223.8	18 41 46.8	224.1
Yellowknife, N.W.T.	+62 26.5	-114 23.8	11 12 48.0	83.6	11 16 00.9	83.9	14 57 16.2	5 23.7	18 37 54.3	223.9	18 41 06.1	224.1
Vancouver, B.C.	+49 15.0	-123 06.0	..	..	..	..	14 57 36.4	5 24.9	18 38 23.9	223.8	18 41 35.8	224.1
Whitehorse, Y.T.	+60 43.0	-135 03.0	..	..	..	..	14 58 03.0	5 24.8	18 38 48.5	223.8	18 42 00.2	224.1
							14 57 38.0	5 25.3	18 38 36.9	223.8	18 41 48.9	224.0
Martinique Fort-de-France	+14 36.0	-61 05.0	11 13 58.4	83.4	11 17 10.1	83.7	14 58 09.7	5 19.1	18 38 23.1	224.2	18 41 33.9	224.5
Bermuda Hamilton	+32 18.0	-64 48.0	11 13 43.4	83.5	11 16 55.5	83.8	14 57 55.3	5 21.1	18 38 09.5	224.1	18 41 20.6	224.3
Puerto Rico San Juan	+18 29.0	-66 08.0	11 13 57.7	83.5	11 17 09.7	83.7	14 58 13.3	5 19.8	18 38 25.2	224.2	18 41 36.0	224.5
Haiti Port-au-Prince	+18 32.0	-72 20.0	11 13 59.2	83.5	11 17 11.4	83.8	14 58 21.8	5 20.2	18 38 33.2	224.2	18 41 44.1	224.4
Jamaica Kingston	+17 58.0	-76 48.0	11 14 00.1	83.5	11 17 12.4	83.8	14 58 28.1	5 20.4	18 38 39.9	224.2	18 41 50.7	224.4
Bahamas Nassau	+25 03.6	-77 20.7	11 13 53.7	83.5	11 17 06.0	83.8	14 58 20.1	5 21.1	18 38 32.2	224.1	18 41 43.2	224.4
Cuba Havana	+23 08.0	-82 23.0	11 13 55.1	83.5	11 17 07.6	83.8	14 58 28.2	5 21.2	18 38 41.0	224.1	18 41 52.0	224.4
Mexico												
Mexico City	+19 25.0	-99 10.0	..	..	..	..	14 58 47.3	5 21.9	18 39 07.9	224.1	18 42 18.9	224.4
Monterrey	+25 40.0	-100 20.0	..	..	..	..	14 58 39.3	5 22.5	18 39 00.7	224.1	18 42 11.8	224.3
Guadalajara	+20 40.0	-103 21.0	..	..	..	..	14 58 48.0	5 22.2	18 39 11.5	224.1	18 42 22.5	224.3
Veracruz	+19 26.1	-96 23.0	..	..	..	..	14 58 45.4	5 21.7	18 39 04.3	224.1	18 42 15.2	224.4
Guatemala Guatemala City	+14 38.0	-90 22.0	..	..	..	..	14 58 46.5	5 20.9	18 39 02.6	224.2	18 42 13.5	224.4
El Salvador San Salvador	+13 40.0	-89 10.0	..	..	..	..	14 58 46.5	5 20.7	18 39 02.3	224.2	18 42 13.1	224.4
Honduras Tegucigalpa	+14 05.0	-87 14.0	..	..	..	..	14 58 44.2	5 20.6	18 38 59.1	224.2	18 42 09.9	224.4
Belize Belmopan	+17 13.0	-88 48.0	..	..	..	..	14 58 42.0	5 21.1	18 38 57.1	224.2	18 42 07.9	224.4
Nicaragua Managua	+12 06.0	-86 18.0	..	..	..	..	14 58 45.4	5 20.4	18 39 00.4	224.2	18 42 11.1	224.5
Venezuela Caracas	+10 30.0	-66 55.0	11 14 03.4	83.4	11 17 15.3	83.7	14 58 22.6	5 19.0	18 38 35.6	224.3	18 41 46.4	224.5
Costa Rica San Jose	+9 59.0	-84 04.0	..	..	..	..	14 58 45.3	5 20.0	18 39 00.0	224.2	18 42 10.8	224.5
Panama Panama City	+8 57.0	-79 30.0	11 14 05.9	83.5	11 17 18.2	83.7	14 58 41.1	5 19.7	18 38 55.0	224.2	18 42 05.7	224.5
Argentina												
Buenos Aires	-34 40.0	-58 30.0	11 13 51.8	83.1	11 17 03.1	83.4	14 58 34.0	5 14.2	18 39 27.3	224.5	18 42 37.9	224.8
Cordoba	-31 25.0	-64 11.0	11 13 57.0	83.1	11 17 08.5	83.4	14 58 41.4	5 14.7	18 39 29.0	224.5	18 42 39.6	224.8
Falkland Islands Stanley	-51 41.5	-57 51.5	..	..	..	..	14 58 32.3	5 13.1	18 39 50.3	224.6	18 43 01.2	224.8

Location	Position		Ingress Exterior Contact		Ingress Interior Contact		Least Angular Distance		Egress Interior Contact		Egress Exterior Contact	
	Latitude	Longitude	UT	P	UT	P	UT	Separation	UT	P	UT	P
Brazil												
Rio de Janeiro	- 8 03.0	- 34 54.0	11 13 41.3	83.2	11 16 52.1	83.5	14 57 42.0	5 15.3	18 38 22.4	224.4	18 41 33.3	224.7
Belo Horizonte	-22 54.5	- 43 11.8	11 13 47.8	83.1	11 16 58.9	83.4	14 58 06.5	5 14.3	18 38 53.3	224.5	18 42 04.1	224.7
Sao Paulo	-19 55.1	- 43 56.3	11 13 49.7	83.2	11 17 00.8	83.4	14 58 06.1	5 14.6	18 38 49.4	224.5	18 42 00.1	224.7
Brasilia	-23 33.0	- 46 38.0	11 13 50.8	83.1	11 17 01.9	83.4	14 58 12.6	5 14.5	18 38 57.9	224.5	18 42 08.6	224.7
Porto Alegre	-15 45.0	- 47 57.0	11 13 54.8	83.2	11 17 06.0	83.5	14 58 10.7	5 15.2	18 38 47.3	224.4	18 41 58.0	224.7
	-30 02.0	- 51 13.8	11 13 50.8	83.1	11 17 02.1	83.4	14 58 22.5	5 14.2	18 39 12.7	224.5	18 42 23.4	224.8
Chile												
Santiago	-33 30.0	- 70 40.0	.	..	.	..	14 58 49.6	5 14.9	18 39 39.3	224.5	18 42 49.9	224.8
Concepcion	-36 50.0	- 73 03.0	.	..	.	..	14 58 52.0	5 14.7	18 39 46.2	224.5	18 42 56.8	224.8
Colombia												
Medellin	+ 6 14.2	- 75 34.5	11 14 07.2	83.4	11 17 19.3	83.7	14 58 38.7	5 19.1	18 38 53.0	224.3	18 42 03.6	224.5
Bogota	+ 4 38.0	- 74 05.0	11 14 07.7	83.4	11 17 19.8	83.7	14 58 38.1	5 18.9	18 38 53.0	224.3	18 42 03.6	224.5
Guyana												
Georgetown	+ 6 46.0	- 58 10.0	11 14 01.0	83.4	11 17 12.6	83.6	14 58 12.3	5 18.1	18 38 28.8	224.3	18 41 39.5	224.5
Suriname												
Paramaribo	+ 5 52.0	- 55 14.0	11 13 59.4	83.4	11 17 10.9	83.6	14 58 08.1	5 17.8	18 38 26.2	224.3	18 41 36.9	224.6
French Guiana												
Cayenne	+ 4 55.0	- 52 18.0	11 13 57.5	83.4	11 17 08.9	83.6	14 58 03.9	5 17.6	18 38 23.8	224.3	18 41 34.5	224.6
Bolivia												
Santa Cruz	-17 45.0	- 63 14.0	11 14 04.5	83.2	11 17 16.1	83.5	14 58 36.5	5 15.9	18 39 08.6	224.4	18 42 19.2	224.7
Cochabamba	-17 23.0	- 66 10.0	11 14 05.8	83.2	11 17 17.5	83.5	14 58 40.7	5 16.1	18 39 11.9	224.4	18 42 22.4	224.7
Paraguay												
Asuncion	-25 15.0	- 57 40.0	11 13 58.1	83.2	11 17 09.5	83.4	14 58 30.8	5 14.9	18 39 12.6	224.5	18 42 23.3	224.7
Ecuador												
Quito	- 0 15.0	- 78 35.0	11 14 09.2	83.4	11 17 21.4	83.7	14 58 48.0	5 18.6	18 39 05.7	224.3	18 42 16.4	224.6
Peru												
Lima	-12 06.0	- 77 03.0	.	..	.	..	14 58 53.3	5 17.3	18 39 19.4	224.4	18 42 29.9	224.6
Uruguay												
Montevideo	-34 53.0	- 56 10.0	11 13 50.3	83.1	11 17 01.6	83.3	14 58 30.8	5 14.0	18 39 25.1	224.5	18 42 35.8	224.8
Easter Island	-27 09.0	-109 26.0	.	..	.	..	14 59 21.2	5 17.5	18 40 19.1	224.4	18 43 29.8	224.6
Pitcairn Islands	-25 04.0	-130 06.0	.	..	.	..	.	..	18 40 38.8	224.3	18 43 49.8	224.5
French Polynesia	-17 32.0	-149 34.0	.	..	.	..	.	..	18 40 47.1	224.2	18 43 58.6	224.4
Cook Islands	-21 12.0	-159 46.0	.	..	.	..	.	..	18 40 54.7	224.2	18 44 06.3	224.4
American Samoa	-14 16.8	-170 42.0	.	..	.	..	.	..	18 40 51.1	224.1	18 44 03.1	224.3
Tokelau	- 9 21.9	-171 12.9	.	..	.	..	.	..	18 40 46.1	224.0	18 43 58.1	224.3
Tonga	-21 08.0	-175 12.0	.	..	.	..	.	..	18 40 57.0	224.1	18 44 09.0	224.4
Tuvalu	- 8 31.3	+179 11.9	.	..	.	..	.	..	18 40 44.7	224.0	18 43 57.0	224.3
Vaiaku, Funafuti												

Location	Position		Ingress Exterior Contact		Ingress Interior Contact		Least Angular Distance Separation		Egress Interior Contact		Egress Exterior Contact			
	Latitude	Longitude	h	m	s	°	h	m	s	°	h	m	s	°
Azerbaijan Baku	+40 22.8	+ 49 53.5	11	11	19.1	83.3	11	14	30.2	83.5	14	55	34.8	5 20.2
Saudi Arabia Riyadh	+24 39.0	+ 46 46.0	11	11	16.9	83.2	11	14	27.6	83.4	14	55	30.6	5 18.3
Iraq Baghdad	+33 19.5	+ 44 25.3	11	11	22.9	83.2	11	14	33.7	83.5	14	55	33.4	5 19.2
Yemen Sana'a	+15 20.9	+ 44 12.4	11	11	19.5	83.1	11	14	30.0	83.4	14	55	32.9	5 17.1
Lebanon Beirut	+33 53.2	+ 35 30.8	11	11	35.9	83.2	11	14	46.7	83.5	14	55	38.8	5 19.1
Israel Tel Aviv	+32 04.0	+ 34 47.0	11	11	36.6	83.2	11	14	47.4	83.5	14	55	38.8	5 18.8
Egypt Cairo	+30 03.5	+ 31 13.7	11	11	41.9	83.2	11	14	52.6	83.5	14	55	41.2	5 18.5
Turkey Istanbul	+41 01.0	+ 28 58.0	11	11	46.9	83.3	11	14	57.8	83.6	14	55	46.4	5 19.8
Russia														
Novosibirsk	+55 01.0	+ 83 00.0	11	11	07.4	83.4	11	14	19.3	83.6	14	55	48.0	5 22.2
Yekaterinburg	+56 50.0	+ 60 35.0	11	11	22.5	83.4	11	14	34.0	83.7	14	55	50.2	5 21.8
Nizhny Novgorod	+56 20.0	+ 44 00.0	11	11	35.8	83.4	11	14	47.3	83.7	14	55	50.2	5 21.8
Magadan	+59 34.0	+150 48.0	11	11	34.1	83.5	11	14	46.6	83.8	18	38	39.8	223.7
Tiksi	+71 38.0	+128 52.0	11	11	41.6	83.4	11	14	53.0	83.7	18	38	13.1	223.7
Moscow	+55 45.1	+ 37 37.1	11	11	41.6	83.4	11	14	53.0	83.7	14	55	52.0	5 21.6
Murmansk	+68 58.0	+ 33 05.0	11	11	52.6	83.5	11	15	04.4	83.7	14	56	09.0	5 22.9
St. Petersburg	+59 57.0	+ 30 19.0	11	11	50.7	83.4	11	15	02.1	83.7	14	55	59.7	5 22.0
Somalia Mogadishu	+ 2 02.0	+ 45 21.0	11	11	18.5	83.0	11	14	28.9	83.3	14	55	38.9	5 15.6
Tanzania Dar es Salaam	- 6 48.0	+ 39 17.0	11	11	31.1	83.0	11	14	41.3	83.2	14	55	50.1	5 14.5
Ethiopia Addis Ababa	+ 9 01.8	+ 38 44.4	11	11	28.7	83.1	11	14	39.1	83.3	14	55	38.8	5 16.2
Kenya Nairobi	- 1 17.0	+ 36 49.0	11	11	33.8	83.0	11	14	44.1	83.2	14	55	47.0	5 15.0
Mozambique Maputo	-25 58.0	+ 32 35.0	11	11	50.4	82.9	11	15	00.6	83.1	14	56	18.5	5 12.8
Uganda Kampala	+ 0 18.8	+ 32 34.9	11	11	41.1	83.0	11	14	51.3	83.3	14	55	49.3	5 15.1
Sudan Khartoum	+15 38.0	+ 32 32.0	11	11	39.2	83.1	11	14	49.6	83.4	14	55	41.1	5 16.8
Mauritius Port Louis	-20 10.0	+ 57 31.0	11	11	09.5	82.9	11	14	20.0	83.1	14	55	41.1	5 16.8
Rodrigues Island Port Mathurin	-19 41.0	+ 63 25.0	11	11	01.8	82.8	11	14	12.4	83.1	14	55	41.1	5 16.8
Seychelles Victoria, Mahe	- 4 37.0	+ 55 27.0	11	11	04.6	82.9	11	14	15.1	83.2	14	55	41.1	5 16.8
Madagascar Antananarivo	-18 56.0	+ 47 31.0	11	11	22.9	82.9	11	14	33.2	83.1	14	55	41.1	5 16.8
Maldives Male	+ 4 10.5	+ 73 30.5	11	10	40.6	83.0	11	13	51.5	83.2	14	55	41.1	5 16.8

TRANSIT OF MERCURY OF 2016 MAY 9

Location	Position Latitude Longitude		Ingress Exterior Contact UT		Ingress Interior Contact UT		Least Angular Distance UT		Egress Interior Contact UT		Egress Exterior Contact UT	
Kerguelen Islands Port-aux-Francais	-49 21.0	+ 70 13.0	h m s °	82.8	h m s °	83.0	h m s °	83.0	h m s °	83.0	h m s °	83.0
Comoros Islands Moroni	-11 45.0	+ 43 12.0	h m s °	82.9	h m s °	83.2	h m s °	83.2	h m s °	83.2	h m s °	83.2
Zimbabwe Harare	-17 51.8	+ 31 01.8	h m s °	82.9	h m s °	83.2	h m s °	83.2	h m s °	83.2	h m s °	83.2
Zambia Lusaka	-15 25.0	+ 28 17.0	h m s °	82.9	h m s °	83.2	h m s °	83.2	h m s °	83.2	h m s °	83.2
South Africa, Rep. of Johannesburg	-26 12.3	+ 28 02.7	h m s °	82.9	h m s °	83.1	h m s °	83.1	h m s °	83.1	h m s °	83.1
Cape Town	-33 55.5	+ 18 25.4	h m s °	82.9	h m s °	83.1	h m s °	83.1	h m s °	83.1	h m s °	83.1
Namibia Windhoek	-22 34.2	+ 17 05.0	h m s °	82.9	h m s °	83.2	h m s °	83.2	h m s °	83.2	h m s °	83.2
Angola Luanda	- 8 50.3	+ 13 14.1	h m s °	83.0	h m s °	83.3	h m s °	83.3	h m s °	83.3	h m s °	83.3
Congo, Democratic Republic of Kinshasa	- 4 19.5	+ 15 19.3	h m s °	83.0	h m s °	83.3	h m s °	83.3	h m s °	83.3	h m s °	83.3
Libya Benghazi	+32 07.0	+ 20 04.0	h m s °	83.3	h m s °	83.5	h m s °	83.5	h m s °	83.5	h m s °	83.5
Tripoli	+32 54.1	+ 13 11.1	h m s °	83.3	h m s °	83.6	h m s °	83.6	h m s °	83.6	h m s °	83.6
Central African Republic Bangui	+ 4 22.0	+ 18 35.0	h m s °	83.1	h m s °	83.3	h m s °	83.3	h m s °	83.3	h m s °	83.3
Chad N'Djamena	+12 06.7	+ 15 02.1	h m s °	83.1	h m s °	83.4	h m s °	83.4	h m s °	83.4	h m s °	83.4
Tunisia Tunis	+36 48.0	+ 10 11.0	h m s °	83.3	h m s °	83.6	h m s °	83.6	h m s °	83.6	h m s °	83.6
Cameroon Yaounde	+ 3 52.0	+ 11 31.0	h m s °	83.1	h m s °	83.4	h m s °	83.4	h m s °	83.4	h m s °	83.4
Nigeria Lagos	+ 6 27.2	+ 3 23.8	h m s °	83.1	h m s °	83.4	h m s °	83.4	h m s °	83.4	h m s °	83.4
Algeria Algiers	+36 42.0	+ 3 13.0	h m s °	83.3	h m s °	83.6	h m s °	83.6	h m s °	83.6	h m s °	83.6
Niger Niamey	+13 31.3	+ 2 06.3	h m s °	83.2	h m s °	83.5	h m s °	83.5	h m s °	83.5	h m s °	83.5
Ghana Accra	+ 5 33.0	- 0 12.0	h m s °	83.2	h m s °	83.4	h m s °	83.4	h m s °	83.4	h m s °	83.4
Ivory Coast Abidjan	+ 5 20.2	- 4 01.6	h m s °	83.2	h m s °	83.4	h m s °	83.4	h m s °	83.4	h m s °	83.4
Morocco Rabat	+34 02.0	- 6 50.0	h m s °	83.4	h m s °	83.6	h m s °	83.6	h m s °	83.6	h m s °	83.6
Mali Bamako	+12 39.0	- 8 00.0	h m s °	83.2	h m s °	83.5	h m s °	83.5	h m s °	83.5	h m s °	83.5
Liberia Monrovia	+ 6 19.0	- 10 46.8	h m s °	83.2	h m s °	83.5	h m s °	83.5	h m s °	83.5	h m s °	83.5
Western Sahara El Aaiun	+27 09.2	- 13 12.2	h m s °	83.3	h m s °	83.6	h m s °	83.6	h m s °	83.6	h m s °	83.6
Sierra Leone Freetown	+ 8 29.1	- 13 14.1	h m s °	83.2	h m s °	83.5	h m s °	83.5	h m s °	83.5	h m s °	83.5
Guinea-Bissau Bissau	+11 51.0	- 15 34.0	h m s °	83.3	h m s °	83.5	h m s °	83.5	h m s °	83.5	h m s °	83.5

Location	Position		Ingress		Ingress		Least		Egress		Egress	
	Latitude	Longitude	UT	P	UT	P	Angular Distance	Separation	UT	P	UT	P
Mauritania Nouakchott	+18 06.0	- 15 57.0	h m s 11 13 05.3	° 83.3	h m s 11 16 16.0	° 83.6	h m s 14 56 48.0	' '' 5 17.4	h m s 18 37 36.9	° 224.2	h m s 18 40 48.4	° 224.5
Senegal Dakar	+14 41.6	- 17 26.8	11 13 09.3	83.3	11 16 20.0	83.5	14 56 52.8	5 17.0	18 37 40.8	224.2	18 40 52.2	224.5
Albania Tirana	+41 19.8	+ 19 49.2	11 12 00.0	83.3	11 15 10.9	83.6	14 55 54.3	5 19.8	..	...	..	...
Ukraine Kiev	+50 27.0	+ 30 31.4	11 11 47.1	83.4	11 14 58.3	83.6	14 55 51.1	5 21.0	..	...	..	...
Hungary Budapest	+47 28.3	+ 19 03.0	11 12 01.0	83.4	11 15 12.1	83.6	14 55 57.7	5 20.5	..	...	..	...
Moldova Chisinau	+47 00.6	+ 28 52.1	11 11 48.3	83.4	11 14 59.4	83.6	14 55 49.7	5 20.5	..	...	..	...
Belarus Minsk	+53 54.0	+ 27 34.0	11 11 51.5	83.4	11 15 02.8	83.7	14 55 55.6	5 21.3	..	...	..	...
Romania Bucharest	+44 25.9	+ 26 06.2	11 11 51.4	83.3	11 15 02.4	83.6	14 55 50.3	5 20.2	..	...	..	...
Finland Helsinki	+60 10.3	+ 24 56.2	11 11 55.8	83.4	11 15 07.3	83.7	14 56 02.7	5 22.0	..	...	..	...
Latvia Riga	+56 56.9	+ 24 06.4	11 11 55.9	83.4	11 15 07.3	83.7	14 56 00.4	5 21.6	..	...	..	...
Greece Athens	+37 58.0	+ 23 43.0	11 11 54.2	83.3	11 15 05.1	83.6	14 55 49.6	5 19.4	..	...	..	...
Bulgaria Sofia	+42 42.0	+ 23 20.0	11 11 55.0	83.3	11 15 06.0	83.6	14 55 51.7	5 20.0	..	...	..	...
Poland Warsaw	+52 13.8	+ 21 00.7	11 11 58.8	83.4	11 15 10.0	83.7	14 55 58.9	5 21.1	..	...	..	...
Serbia and Montenegro Belgrade	+44 49.2	+ 20 27.7	11 11 59.1	83.4	11 15 10.1	83.6	14 55 55.2	5 20.2	..	...	..	...
Bosnia-Herzegovina Sarajevo	+43 50.9	+ 18 21.4	11 12 02.0	83.4	11 15 13.0	83.6	14 55 56.7	5 20.1	..	...	..	...
Svalbard Longyearbyen	+78 13.0	+ 15 33.0	11 12 04.8	83.5	11 15 16.8	83.8	14 56 26.0	5 23.7	18 37 40.5	223.8	18 40 52.9	224.0
Sweden Stockholm	+59 21.0	+ 18 04.0	11 12 02.3	83.5	11 15 13.8	83.7	14 56 06.3	5 21.9	18 37 25.3	223.8	18 40 37.7	224.1
Austria Vienna	+48 12.5	+ 16 22.4	11 12 04.5	83.4	11 15 15.6	83.6	14 56 00.4	5 20.6	..	...	..	...
Croatia Zagreb	+45 49.0	+ 15 59.0	11 12 05.2	83.4	11 15 16.2	83.6	14 55 59.7	5 20.3	..	...	..	...
Czech Republic Prague	+50 05.0	+ 14 25.0	11 12 06.8	83.4	11 15 18.0	83.7	14 56 03.1	5 20.8	..	...	..	...
Germany Munich	+48 08.0	+ 11 34.0	11 12 10.7	83.4	11 15 21.8	83.7	14 56 04.9	5 20.6	..	...	..	...
Stuttgart	+48 46.7	+ 9 10.8	11 12 13.7	83.4	11 15 24.8	83.7	14 56 07.5	5 20.7	18 37 20.7	223.9	18 40 33.0	224.2
Dusseldorf	+51 14.2	+ 6 47.0	11 12 16.0	83.4	11 15 27.2	83.7	14 56 10.7	5 21.0	18 37 21.2	223.9	18 40 33.5	224.2
San Marino San Marino	+43 56.0	+ 12 26.0	11 12 10.3	83.4	11 15 21.3	83.6	14 56 02.5	5 20.1	..	...	..	...
Italy Rome	+41 54.0	+ 12 30.0	11 12 10.6	83.4	11 15 21.5	83.6	14 56 01.9	5 19.8	..	...	..	...
Milan	+45 27.8	+ 9 11.4	11 12 14.4	83.4	11 15 25.5	83.6	14 56 06.4	5 20.3	..	...	..	...

TRANSIT OF MERCURY OF 2016 MAY 9

Location	Position		Ingress		Ingress		Least		Egress		Egress	
	Latitude	Longitude	Exterior Contact UT	P	Interior Contact UT	P	Angular Distance UT	Separation "	Interior Contact UT	P	Exterior Contact UT	P
Denmark Copenhagen	+55° 40.6'	+ 12 34.1	h m s	°	h m s	°	h m s	' "	h m s	°	h m s	"
			11 12 08.3	83.4	11 15 19.6	83.7	14 56 07.7	5 21.5	18 37 23.0	223.9	18 40 35.3	224.1
Norway Oslo	+59 57.0	+ 10 45.4	11 12 09.5	83.5	11 15 21.0	83.7	14 56 11.8	5 21.9	18 37 24.9	223.8	18 40 37.3	224.1
Switzerland Zurich	+47 22.0	+ 8 33.0	11 12 14.8	83.4	11 15 25.9	83.7	14 56 07.6	5 20.5	18 37 20.5	223.9	18 40 32.7	224.2
Netherlands Amsterdam	+52 22.4	+ 4 53.5	11 12 17.8	83.4	11 15 29.1	83.7	14 56 13.0	5 21.1	18 37 21.6	223.9	18 40 33.8	224.2
France	+41 55.6	+ 8 44.2	11 12 16.0	83.4	11 15 27.0	83.6	14 56 06.0	5 19.9	18 37 20.2	224.0	18 40 32.4	224.2
	+43 17.8	+ 5 22.2	11 12 20.4	83.4	11 15 31.4	83.6	14 56 10.1	5 20.0	18 37 20.9	223.9	18 40 33.0	224.2
	+48 51.4	+ 2 21.0	11 12 22.3	83.4	11 15 33.5	83.7	14 56 14.5	5 20.7	18 37 20.5	223.9	18 40 32.7	224.2
									18 37 21.6	223.9	18 40 33.8	224.2
Spain	+41 23.0	+ 2 11.0	11 12 25.6	83.4	11 15 36.6	83.6	14 56 13.6	5 19.8	18 37 20.5	224.0	18 40 32.5	224.2
	+40 24.0	- 3 41.0	11 12 34.4	83.4	11 15 45.4	83.7	14 56 21.0	5 19.8	18 37 21.4	224.0	18 40 33.4	224.3
United Kingdom	+51 30.5	- 0 07.5	11 12 24.1	83.4	11 15 35.4	83.7	14 56 17.7	5 21.0	18 37 21.7	223.9	18 40 33.8	224.2
	+52 29.0	- 1 53.6	11 12 25.7	83.5	11 15 37.0	83.7	14 56 19.8	5 21.2	18 37 22.2	223.9	18 40 34.3	224.2
	+55 57.0	- 3 09.6	11 12 25.2	83.5	11 15 36.6	83.7	14 56 21.9	5 21.6	18 37 23.6	223.9	18 40 35.7	224.2
	+51 01.1	- 3 06.0	11 12 27.9	83.4	11 15 39.2	83.7	14 56 20.8	5 21.0	18 37 22.0	223.9	18 40 34.0	224.2
	+53 20.9	- 6 15.6	11 12 30.1	83.5	11 15 41.4	83.7	14 56 24.5	5 21.3	18 37 23.2	223.9	18 40 35.2	224.2
Ireland Dublin	+62 00.0	- 6 47.0	11 12 24.8	83.5	11 15 36.4	83.8	14 56 26.7	5 22.3	18 37 27.1	223.9	18 40 39.3	224.1
Faroe Islands Torshavn	+38 42.8	- 9 08.4	11 12 43.0	83.4	11 15 54.1	83.7	14 56 28.7	5 19.7	18 37 23.0	224.0	18 40 34.9	224.3
Portugal Lisbon	- 7 55.7	- 14 24.7	11 13 10.4	83.1	11 16 20.8	83.4	14 57 04.0	5 14.5	18 38 07.3	224.4	18 41 18.6	224.6
Ascension Island Georgetown	+28 09.0	- 15 25.0	11 12 58.8	83.4	11 16 09.8	83.6	14 56 41.8	5 18.6	18 37 29.5	224.1	18 40 41.1	224.4
Can. Islands Las Palmas de Gran Canaria	+32 39.1	- 16 54.6	11 12 58.0	83.4	11 16 09.1	83.6	14 56 42.1	5 19.1	18 37 28.0	224.1	18 40 39.6	224.3
Madeira Funchal	+64 08.0	- 21 56.0	11 12 34.7	83.5	11 15 46.5	83.8	14 56 39.5	5 22.7	18 37 31.9	223.9	18 40 43.9	224.1
Iceland Reykjavik	+14 55.2	- 23 30.5	11 13 18.7	83.3	11 16 29.5	83.6	14 57 03.6	5 17.3	18 37 44.4	224.2	18 40 55.7	224.5
Cape Verde Islands Praia, Santiago	+37 44.0	- 25 40.0	11 13 05.4	83.4	11 16 16.7	83.7	14 56 53.1	5 20.0	18 37 30.9	224.1	18 40 42.4	224.3
Azores Ponta Delgada	-54 16.9	- 36 30.5	11 13 17.6	82.9	11 16 28.6	83.2	14 58 09.2	5 12.3	18 39 39.5	224.6	18 40 42.4	224.3
South Georgia Grytviken	+64 10.0	- 51 44.0	11 12 50.8	83.6	11 16 03.0	83.9	14 57 03.7	5 23.3	18 37 44.6	223.9	18 40 56.4	224.1
Greenland Nuuk												

Dot leaders indicate the phenomenon occurs below the horizon.

Joint publications of HM Nautical Almanac Office (UKHO) and the United States Naval Observatory

These publications are published by and available from, UKHO Distributors, and the Superintendent of Documents, U.S. Government Printing Office (USGPO) except where noted.

The Astronomical Almanac (AsA) and *The Astronomical Almanac Online* (AsA Online) contain ephemerides of the Sun, Moon, planets and their natural satellites, as well as data on eclipses and other astronomical phenomena. The AsA is an annual volume while AsA Online is updated annually. The data are calculated cooperatively by the British and American offices. A full list of contributors is given on page vii of the AsA and on AsA Online. (UKHO GP100)

The Nautical Almanac contains ephemerides at an interval of one hour and auxiliary astronomical data for marine navigation. (UKHO NP314)

The Air Almanac contains ephemerides at an interval of ten minutes and auxiliary astronomical data for air navigation. This publication is now distributed solely on CD-ROM and is only available from USGPO.

Other publications of HM Nautical Almanac Office (UKHO)

The Star Almanac for Land Surveyors (NP321) contains the Greenwich hour angle of Aries and the position of the Sun, tabulated for every six hours, and represented by monthly polynomial coefficients. Positions of all stars brighter than magnitude 4.0 are tabulated monthly to a precision of 0.1 in right ascension and 1" in declination. A CD-ROM is included which contains the electronic edition plus coefficients, in ASCII format, representing the data.

NavPac and Compact Data for 2011–2015 (DP330) contains software, algorithms and data, which are mainly in the form of polynomial coefficients, for calculating the positions of the Sun, Moon, navigational planets and bright stars. It enables navigators to compute their position at sea from sextant observations using an IBM PC or compatible for the period 1986–2015. The tabular data are also supplied as ASCII files on the CD-ROM. The website <http://astro.ukho.gov.uk/nao/navpac/> provides a home for issues related to NavPac.

Planetary and Lunar Coordinates, 2001–2020 provides low-precision astronomical data and phenomena for use well in advance of the annual ephemerides. It contains heliocentric, geocentric, spherical and rectangular coordinates of the Sun, Moon and planets, eclipse maps and auxiliary data. All the tabular ephemerides are supplied solely on CD-ROM as ASCII and Adobe's portable document format files. The full printed edition is published in the United States by Willmann-Bell Inc, PO Box 35025, Richmond VA 23235, USA.

Rapid Sight Reduction Tables for Navigation (AP3270 / NP303), 3 volumes, formerly entitled *Sight Reduction Tables for Air Navigation*. Volume 1, selected stars for epoch 2015.0, containing the altitude to 1' and true azimuth to 1° for the seven stars most suitable for navigation, for all latitudes and hour angles of Aries. Volumes 2 and 3 contain altitudes to 1' and azimuths to 1° for integral degrees of declination from N 29° to S 29°, for relevant latitudes and all hour angles at which the zenith distance is less than 95° providing for sights of the Sun, Moon and planets.

The UK Air Almanac (AP1602) contains data useful in the planning of activities where the level of illumination is important, particularly aircraft movements, and is produced to the general requirements of the Royal Air Force. It may be downloaded from the website <http://astro.ukho.gov.uk/nao/publicat/ukaa.html>.

NAO Technical Notes are issued irregularly to disseminate astronomical data concerning ephemerides or astronomical phenomena.

Other publications of the United States Naval Observatory

Astronomical Papers of the American Ephemeris[†] are issued irregularly and contain reports of research in celestial mechanics with particular relevance to ephemerides.

U.S. Naval Observatory Circulars[†] are issued irregularly to disseminate astronomical data concerning ephemerides or astronomical phenomena.

U.S. Naval Observatory Circular No. 179, The IAU Resolutions on Astronomical Reference Systems, Time Scales, and Earth Rotation Models explains resolutions and their effects on the data (see Web Links).

Explanatory Supplement to The Astronomical Almanac, (3rd edition). This book is an authoritative source on the basis and derivation of information contained in *The Astronomical Almanac*. It contains material that is relevant to positional and dynamical astronomy and to chronology. The publication is a collaborative work with authors from the U.S. Naval Observatory, H.M. Nautical Almanac Office, the Jet Propulsion Laboratory, and others. This edition is published by and available from University Science Books, whose UK distributor is Palgrave Macmillan.

MICA is an interactive astronomical almanac for professional applications. Software for both PC systems with Intel processors and Apple Macintosh computers is provided on a single CD-ROM. *MICA* allows a user to compute, to full precision, much of the tabular data contained in *The Astronomical Almanac*, as well as data for specific times and locations. All calculations are made in real time and data are not interpolated from tables. *MICA* is a product of the U.S. Naval Observatory; it is published by and available from Willmann-Bell Inc. The latest version covers the interval 1800-2050.

† Many of these publications are available from the Nautical Almanac Office, U.S. Naval Observatory, Washington, DC 20392-5420, see Web Links on the next page for availability.

Publications of other countries

Apparent Places of Fundamental Stars is prepared by the Astronomisches Rechen-Institut, Heidelberg (www.ari.uni-heidelberg.de). The printed version of APFS gives the data for a few fundamental stars only, together with the explanation and examples. The apparent places of stars using the FK6 or Hipparcos catalogues are provided by the on-line database ARIAPFS (<http://www.ari.uni-heidelberg.de/ariapfs>). The printed booklet also contains the so-called '10-Day-Stars' and the 'Circumpolar Stars' and is available from G. Braun Buchverlag, Erbprinzenstrasse 4 - 12, 76133 Karlsruhe, Germany.

Ephemerides of Minor Planets is prepared annually by the Institute of Applied Astronomy (www.ipa.nw.ru), and published by the Russian Academy of Sciences. Included in this volume are elements, opposition dates and opposition ephemerides of all numbered minor planets. This volume is available from the Institute of Applied Astronomy, Naberezhnaya Kutuzova 10, St. Petersburg, 191187 Russia.

Electronic Publications

The Astronomical Almanac Online: The companion publication of *The Astronomical Almanac*, providing data best presented in machine-readable form. It typically does not duplicate the data from the book. It does, in some cases, provide additional information or greater precision than the printed data. Examples of data found on *The Astronomical Almanac Online* are searchable databâses, eclipse and occultation maps, errata found in the printed publication, and a searchable glossary. It is available at

<http://asa.usno.navy.mil> —  — <http://asa.hmnao.com>

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- U.S. Naval Observatory portal at <http://www.usno.navy.mil/USNO>
- USNO Astronomical Applications Department portal at <http://aa.usno.navy.mil/>
- USNO Data Services at <http://aa.usno.navy.mil/data/>
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- *USNO Circular 179* at http://aa.usno.navy.mil/publications/docs/Circular_179.php
- *The Astronomical Almanac Online*—^{WWW}— at <http://asa.usno.navy.mil>

H.M. Nautical Almanac Office

- General information at <http://www.ukho.gov.uk/HMNAO/>
- *The Astronomical Almanac Online*—^{WWW}— at <http://asa.hmnao.com/>
- Eclipses Online at <http://astro.ukho.gov.uk/eclipse/>
- Online data services at <http://astro.ukho.gov.uk/websurf/>
- Crescent MoonWatch at <http://astro.ukho.gov.uk/moonwatch/>

International Astronomical Organizations

- IAU: International Astronomical Union at <http://www.iau.org>
- IERS: International Earth Rotation and Reference Systems Service at <http://www.iers.org>
- SOFA: IAU Standards of Fundamental Astronomy at <http://www.iausofa.org>
- NSFA: IAU Working Group on Numerical Standards at <http://maia.usno.navy.mil/NSFA/>
- CDS: Centre de Données astronomiques de Strasbourg at <http://cdsweb.u-strasbg.fr>

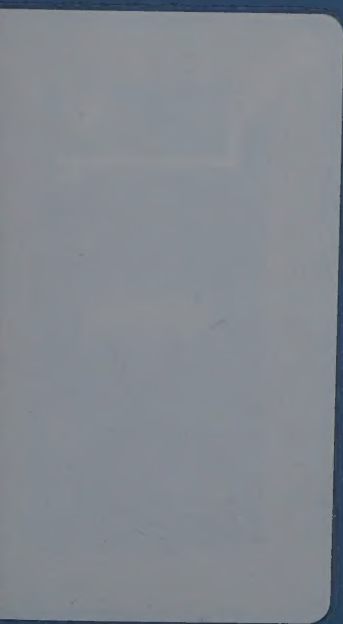
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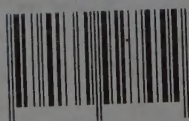


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